

MAINE STREAM EXPLORERS

A treasure hunt to find healthy streams in Maine

Volume 1: Introduction and Sampling Instructions



Portland
Water
District



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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 (*Asellus*), 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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Introduction to Maine Stream Explorers

Maine Stream Explorers is a treasure hunt to find healthy streams in Maine. Volunteers are trained to collect and identify “sensitive”, “moderately sensitive”, and “tolerant” macroinvertebrates in Maine’s streams. 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 streams and lakes have young that live in the water. Many trout fisherman make artificial lures, “flies”, that resemble mayflies, stoneflies, and caddisflies that trout love to eat. Of course, the infamous blackfly starts its life in a stream too. 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 stream. 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 rivers and streams by collecting macroinvertebrates and evaluating how many and what kinds live in a stream. Overall, DEP Biologists have collected more than 1,400 kinds of macroinvertebrates in Maine streams and rivers. Some species require streams with cold, clean water and good habitat. These are the “sensitive” macroinvertebrates in the Stream 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.* They can be found in very nice streams too. Healthy streams often have four or more kinds of “sensitive” macroinvertebrates and a variety of “moderately sensitive” and “tolerant” macroinvertebrates too. Unfortunately, some streams 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 Stream 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 streams 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 streams previously sampled to check up on their condition. You may find streams that are loaded with “sensitive” macroinvertebrates. In other streams, you may find none of them. Regardless, your hard work will provide a valuable assessment of stream health. The program coordinators will compile the results of all the stream 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.

Training

The main goals of the Stream 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 streams. Volunteers in the Stream 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 stream 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. Please be careful walking around and in the stream because of slippery rocks.

Equipment

The sampling equipment kit contains:

- Net
- 3 trays (6”x9” or larger)
- Ice cube trays
- Plastic spoons
- Brushes/tweezers
- Pipettes
- Laminated guide and macroinvertebrate keys
- Magnifying lens
- Petri dishes and containers
- Magiscope (only some kits have this)



Sampling Overview

You and your partner(s) will collect 6 samples at your location. Some habitats within a stream are easier to sample and have a greater diversity of macroinvertebrates. The target habitats, in order of preference, are the following:

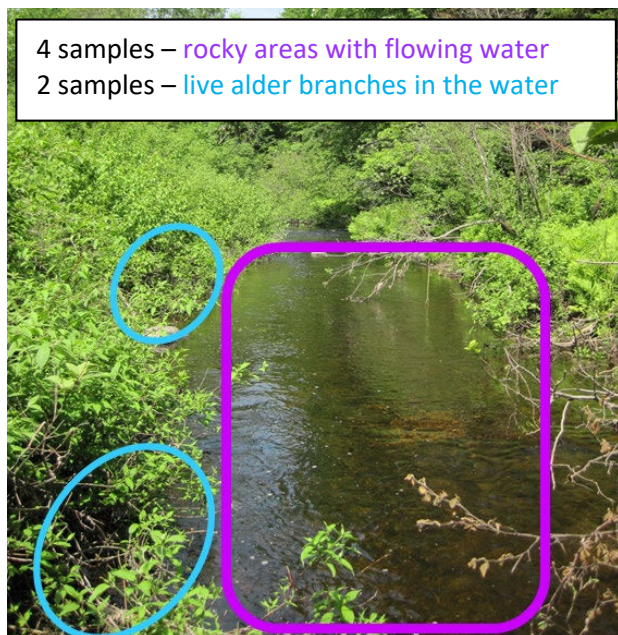
1. rocky areas with flowing water
2. exposed tree roots in the water along the side of the stream
3. logs or branches in the water
4. plants growing in the water

Look around to see which of the target habitats are most common in your stream. In general, you want to allocate the samples among those target habitats based on their order of preference (listed above) and how common they are at your location. If possible, collect most of your samples (4 to 6) from the highest priority habitat, such as rocky areas with flowing water. If the highest priority habitat is uncommon, then allocate more samples in the next highest priority habitat. For example, if your stream only has a small area of rocks but has a lot of tree branches in it, then you would allocate more samples to the branches. Do not ponder too much when deciding what to sample. Use your best judgment and mark down the number of samples collected in the different habitat types on the field sheet.

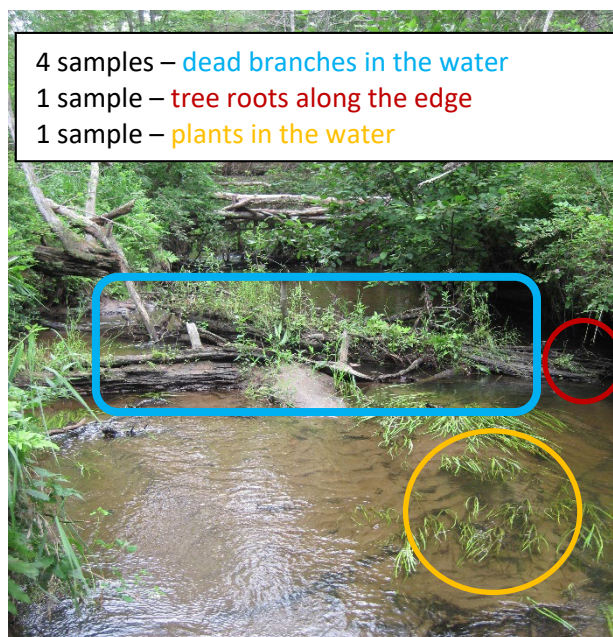
Examples of streams with a variety of habitats and what to sample

	Habitat at the site	What should you collect
Stream 1	Stream has a rocky bottom in areas of flowing water. The stream also has tree roots in the water where flowing water has undercut the stream bank. The stream also has some plants growing in the water along the edge.	4 samples where there are rocks in flowing water, 1 sample at the undercut bank with the tree roots, and 1 sample in the plants growing in the water
Stream 2	The stream has a mix of rocky and sandy substrate. The stream has some large branches but no exposed tree roots or plants growing in the stream.	4 samples where there are rocks in flowing water and 2 samples where there are logs and branches in the water
Stream 3	The stream has a sandy bottom. It has some logs and branches in the water. It also has a small area with an undercut bank and tree roots.	4 samples where there are logs and branches in the water and 2 samples at the undercut bank with the tree roots in the water
Stream 4	The best available habitat is mostly rocky areas in flowing water. There are a few branches but not many.	5 samples where there are rocks in flowing water and 1 sample where there are branches in the water
Stream 5	The stream has equal amounts of rocks, branches, and exposed tree roots.	2 samples where there are rocks in flowing water, 2 samples where there are branches in the water, and 2 samples where there are undercut banks and tree roots in the water
Stream 6	The stream is mucky and difficult to walk in. There are some branches and plants growing in the water.	Don't collect samples. The sampling protocol does not work well for this kind of stream.

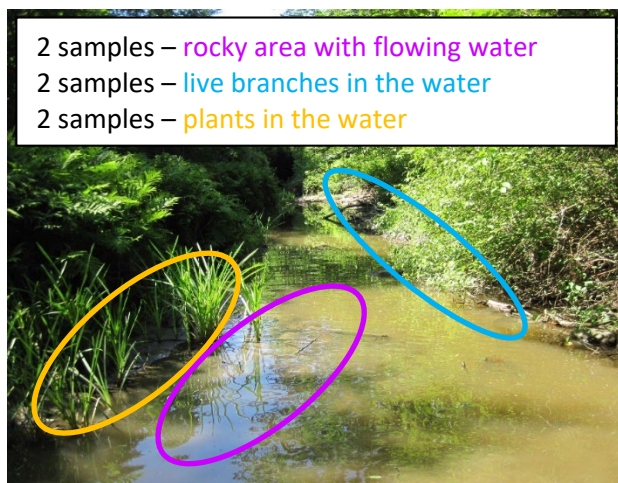
More examples of where to collect samples



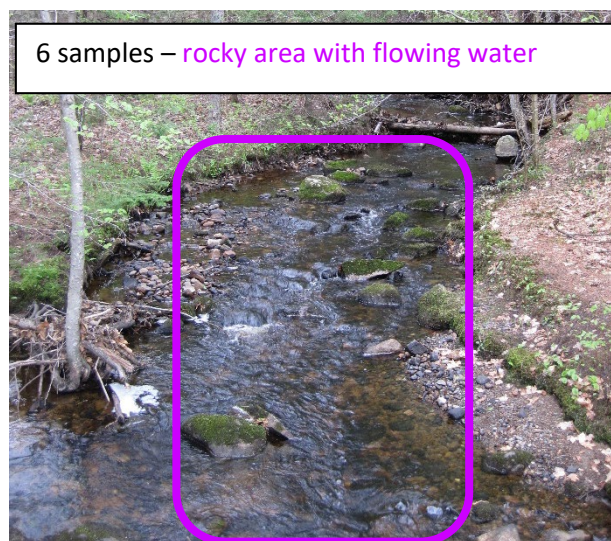
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Sampling rocky areas with flowing water

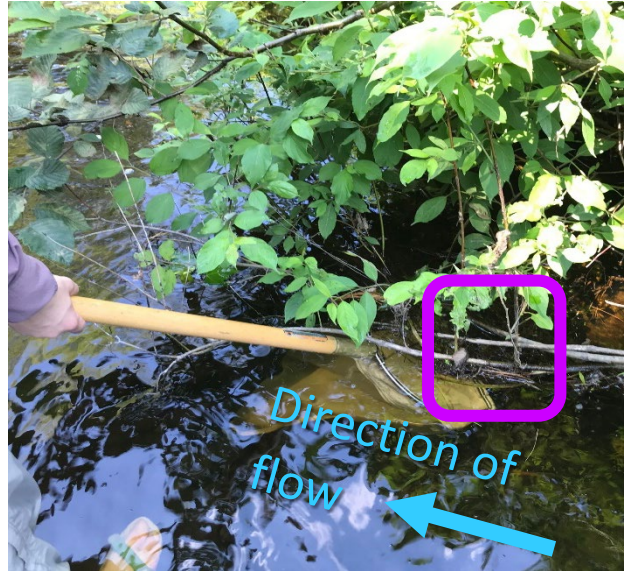
1. Place the net in the water with the opening of the net facing upstream
2. Place the net downstream of rocks small enough to be picked up and cleaned by a second person (try to avoid getting too much sand)
3. Sample an area extending approximately 18 inches upstream of the net
4. The second person picks up one rock at a time, holds it in the front of the net, and wipes off all sides of the rock so stuff on it floats into the net
5. Set the rock off to the side and do the same thing with other rocks in your sample area
6. Keep an eye out for bugs trying to climb out of the net
7. After cleaning all rocks in the sample area, gently massage and agitate the stream bottom with your fingers (avoid getting too much sand and silt, however... skip this step if you see too much sand and silt getting into the net)
8. Repeatedly scoop your net through the water to concentrate the animals into the bottom of the net
9. Wash off and remove branches and large leaves
10. Transfer the contents of the net to a tray with about an inch of water in it



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Sampling underwater roots

1. The first person places the net downstream of the roots in the water
2. If possible, position the net so the roots are in the net
3. Sample an area extending approximately 18 inches upstream of the net
4. If the water is flowing there, then hold the net at an angle so water flows into the net and animals dislodged from the roots will fall into the net
5. If the water is not flowing much there, then hold the net facing up so animals that are dislodged from the roots will fall into the net
6. The second person gently massages and agitates the roots with hands or with a whisk broom
7. You may need to reposition the net several times to sample all parts of the roots
8. Repeatedly scoop your net through the water to concentrate the animals into the bottom of the net
9. Wash off and remove twigs and large leaves from the net
10. Transfer the contents of the net to a tray with about an inch of water in it
11. This process usually takes 2-3 minutes



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Sampling branches and logs in the water

1. The first person places the net in the water downstream of the branches with the opening facing upstream so animals dislodged from the branches will float into the net
2. Sample an area extending approximately 18 inches upstream of the net
3. If possible, position the net so the branches are inside the net
4. The second person gently rubs the branches with hands or a whisk broom to remove animals from them
5. You may need to reposition the net several times to sample all parts of the branches
6. If the branches are positioned horizontal to stream flow, then sample 18 inches of the branches while slowly moving the net sideways to collect animals dislodged from the branches
7. Repeatedly scoop your net through the water to concentrate the animals into the bottom of the net
8. Wash off and remove twigs and large leaves from the net
9. Transfer the contents of the net to a tray with about an inch of water in it
10. This process usually takes 2-3 minutes



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Sampling plants or moss in the water

1. The first person places the net downstream of the plants or moss with the opening of the net facing upstream
2. Sample an area extending approximately 18 inches upstream of the net
3. If possible, position the net so the plants are inside the net
4. The second person gently rubs or agitates the plants or moss with hands or a whisk broom to remove animals from them
5. You may need to reposition the net several times to sample all parts of the plants or moss
6. Rub clean any large leaves or plant parts in the net, then remove them from the net
7. Repeatedly scoop your net through the water to concentrate the animals into the bottom of the net
8. Transfer the contents of the net to a tray with about an inch of water in it
9. This process usually takes 2-3 minutes



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Picking macroinvertebrates from the sample

Place 2 samples in each of the three trays. 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 stream 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 Stream 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 stream 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 the sample location facing upstream and downstream. It would be helpful to take pictures representing the different habitats that you sampled. Write down the name of the team leader and other stream explorers. Record the total time spent at the stream 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 sample location looking upstream and looking downstream. 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 *Glossosoma* at the Northwest River on July 22, 2020, the picture name would be **Northwest_River_07_22_2020_Glossosoma.jpg**. E-mail pictures to Hannah Young with Maine Audubon (conserve@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 stream. Wash the net and pick off any debris. Wash the trays, spoons, ice cube trays, and petri dishes with stream 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.

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, 5th 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)

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

Life in Fresh Water webpage by Jan Hamrsky (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)

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



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