VIRGINIA SAVE OUR STREAMS IZAAK WALTON LEAGUE OF AMERICA

Biological Monitoring Instructions for VA SOS Stream Monitors

Surveying stream macroinvertebrates provides information about the health of your stream. Many stream-dwelling organisms are sensitive to changes in water quality. Their presence or absence can serve as an indicator of environmental conditions.

Before selecting a site to monitor, please follow these rules:

- Check with state and county agencies to make sure you are not disturbing a survey area used by government agencies (over-monitoring may harm the stream).
- Contact local landowners before monitoring to make sure you are not trespassing.
- Ask for permission if you need to cross private land. Most landowners will give permission for your study and may even want to help you conduct your survey.

Monitoring should be conducted at the same station (location) each time you sample during the year. If you want to monitor several stations on your stream, make sure the stations are no closer than one-quarter mile. This means, for example, that if you want to monitor a one-mile segment of a stream, you can have a maximum of four monitoring locations. If the stations are spaced more closely, the monitoring activity may become the main impact on water quality.

Carefully record the location of your monitoring station on your Biological Monitoring Data Form. Include roads, bridges, and significant landmarks. Use your smart phone's GPS functionality to determine your longitude and latitude.

THINGS TO CONSIDER

If you are monitoring more than one station, begin monitoring downstream and move upstream. This will prevent macroinvertebrates disturbed by the first test from washing downstream and being captured in your net a second time. Each survey should record only the organisms present at that particular location and time.

Monitoring should be conducted two times per year at each station, in spring and fall. This monitoring will accurately record the yearly life cycle in the stream. Less frequent monitoring, while still useful, will not give the complete picture of stream life.

When scheduling monitoring events, remember that excessive monitoring can become a major threat to stream health because each monitoring event disturbs the streambed and dislodges macroinvertebrates. In general, monitoring stations should have two months to recover from a monitoring event. It is crucial to the integrity of your data that you do not over-monitor your stations. There is some flexibility in this rule. For example, if an oil spill occurs, you might want to monitor your stream, even if you have done your two surveys for the year. The data you collect might be the only data available on the immediate impacts of the spill.

The methods described in these instructions are for use in wadable streams. To be wadable, the water level in the stream must not exceed the height of your knees. When planning monitoring sessions for younger people, please keep in mind that knee height varies greatly between adults and children.

Safety is critical when monitoring a stream. Do not enter a stream if the water is flowing abnormally fast or high, if the banks are steep or unstable, or during a thunderstorm. If the water smells of raw sewage, do not enter the water; contact state environmental authorities immediately. Monitors in urban-area streams should wear gloves to protect against glass or metal that may be buried in the streambed. Finally, always sanitize your hands and equipment after each monitoring session to avoid bacterial infection.

There are two sampling methods available to collect aquatic macroinvertebrates. Muddy Bottom Sampling is used in streams that do not have riffles, a streambed feature with cobble-sized stones between 2 to 10 inches in diameter where the water bubbles over the rocks. If your stream has riffles, please refer to the Rocky Bottom Sampling section.

MUDDY BOTTOM SAMPLING

The Muddy Bottom Sampling method is intended for volunteers sampling streams that primarily do not have rocky bottoms or riffles. Muddy bottom streams are composed of muddy or sandy substrate, overhanging bank vegetation, and submerged woody and organic debris. This method enables sampling of streams where kick-seining techniques do not yield the best representative sample of macroinvertebrates or allow easy collection from the most productive aquatic habitats.

Monitoring is conducted using an aquatic D-frame or dip net with 500 micron mesh and a four-foot pole. The dip net is used to sample a wide variety of habitats and collect many different kinds of organisms.

Before you begin monitoring, familiarize yourself with the four main habitats that can exist along muddy bottom streams: woody snags, stream banks, riffles, and submerged

aquatic vegetation. Search for these habitats along a 100-meter section upstream from the monitoring station.

Following are simple descriptions of the habitat types and collection techniques for each habitat.

Woody snags

Snags, or submerged woody debris, are areas where tree trunks or limbs have fallen into the stream. Leaves and debris may be collected or tangled in the snag. To sample woody debris, jab the medium-sized submerged material (sticks and branches), scrape along the submerged surface of large material (logs), or pick up and rub woody debris in the net by hand.

Stream banks

Stream banks are the edge of the stream. These may be vegetated, bare soil, undercut, or eroded. Stream banks are sampled in a bottom-to-surface motion, jabbing at the bank to loosen organisms. Each scoop of the net should cover one foot of submerged area.

Riffles

Riffles are shallow, fast-moving areas of water flowing over cobble-sized stones and rocks. To sample a riffle, place the net firmly along the bottom of the stream and use your hands or foot to rub around the cobbles.

Submerged aquatic vegetation

Submerged aquatic vegetation includes any plant growing under or out of the water of the stream. In deep water, plants are sampled by drawing the net through the vegetation from the bottom to the surface of the water. In shallow water, plants are sampling by bumping the net along the bottom of the bed of vegetation.

A single sample of macroinvertebrates consists of collecting 20 "jabs" in productive habitats. A single "jab" consists of aggressively thrusting the net into the target habitat for approximately one meter. This initial jab is then followed by two to three sweeps in the water of the same area to collect dislodged organisms. The sample is then transferred to the sieve bucket or seining device, by banging the net over the bucket opening or by inverting the net into a partially submerged bucket. Transfer sample contents to the sieve bucket after every jab.

Each habitat should be sampled in proportion to its abundance in the stream sample area. For example, if 50 percent of a sample area is woody debris, it should be sampled with ten jabs.

Thoroughly mix the sample in the sieve bucket by swishing it around in shallow water, being careful to keep the entire sample inside. Empty the contents of the bucket onto a flat, light colored surface, such as a white sheet or table. Spread the sample evenly across a square portion of the surface, such that the sample material is not clumped together. Using a stick, divide the sample into a grid with four equal quadrants. Randomly select a quadrant to start sorting and identification.

Using tweezers or your fingers, separate all the organisms from the surface and place them in your collecting container. Plastic ice cube trays filled with stream water are helpful when sorting samples. Sort organisms into similar groups as you separate your sample. Be sure to regularly wet the surface using a spray bottle, as the organisms will begin to dry out. See the "Identification" section for details on identifying the organisms in your sample.

Record the number of individuals you find in each taxonomic group on the tally sheet. Metric calculations should be based on a sample size of at least 100 organisms. Count the number of scuds found in your sample, but do not count them towards the 100 required organisms (in other words, you need at least 100 non-scud organisms for your sample).

If the first grid doesn't yield 100 organisms, move on to a second grid and sort it in its entirety. Record the number of individuals in each taxonomic group on the tally sheet for the second grid. If you do not have 100 organisms after you have picked the second grid, continue on to the third. Continue

MUDDY BOTTOM SAMPLING EQUIPMENT

- Biological Monitoring Data Form for Muddy Bottom Streams
- One D-frame aquatic dip net with mesh of 500 microns
- Portable table
- White sheet or table cover
- One screen-bottom bucket with a mesh of 1/32 inches
- "Field Guide to Aquatic Macroinvertebrates"
- Aquatic thermometer
- Magnifying glass
- Small magnifier boxes (optional)
- Spray bottle
- Ice cube trays or specimen jars for sorting organisms
- Tweezers or forceps
- Clipboard
- Boot-footed waders or waterproof knee boots
- Neoprene gloves, hand, elbow or shoulder length (optional)
- Additional identification resources

sorting grids in their entirety until you have at least 100 organisms or you have sorted the entire sample.

ROCKY BOTTOM SAMPLING

The Rocky Bottom Sampling method is intended for volunteers sampling streams that have rocky bottoms or riffles. A kick-seine net – a finely meshed net with supporting poles on each side – is the best tool to use for collecting macroinvertebrates in rocky bottom streams. The VA SOS Rocky Bottom Sampling method recommends using a kick-seine net with 1/32-inch mesh. The 1/32-inch mesh net will provide you with a large sample because it captures younger, and therefore smaller, organisms of each species, and some state and local government agencies require use of the 1/32-inch mesh.

Select a riffle that is a shallow, fast-moving area of water with a depth of 3 to 12 inches and cobble-sized stones (2 to 10 inches) or larger. Before entering the stream, record observations about riffle composition on the back of the Biological Monitoring Data Form.

Place the kick-seine net at the downstream edge of the riffle. The net should be secured with rocks selected from outside the sample area. Rub the rocks to dislodge any macroinvertebrates outside of the sample area before placing on the bottom of the net, or use dry rocks from outside the stream. Don't allow any water to flow over the top of the net either — organisms can escape over the net. Also, if water is flowing over the top of the net, the water level is too high for safe monitoring.

Monitor a one-foot by one-foot area of the streambed directly in front of the net.

The sample site can be sampled up to four times in order to yield a total of 200 or more macroinvertebrates. It is important to have at least 200 invertebrates by the end of the sampling session.

The length of each sampling period can be adjusted depending on the number of macroinvertebrates found in each sampling period. Each sampling period must be between 20 and 90 seconds. For example, if 100 macroinvertebrates are found during one 30 second sampling period, you will likely only need to monitor for a second 30 second period. Do not do another sampling period once you have reached 200 organisms, if you have already sampled four times, or for longer than 90 seconds.

If you sample the maximum number of seconds for at least three nets and do not reach 200 organisms, you should still record your results and calculate the stream health score.

Once you have determined the length of the sampling period, calculate the amount of time you will spend rubbing rocks versus disturbing the substrate. You should spend 75% of the sampling period rubbing rocks, and the remaining 25% disturbing the substrate. For example, in a 30 second sampling period you will spend 22.5 seconds rubbing rocks and 7.5 seconds disturbing substrate.

Firmly and thoroughly rub your hands over individual cobbles within the sampling area, placing each rock outside of the sampling area when finished. Once you have reached 75% of the sampling period, disturb the sample substrate using a dry rock or garden tool. At the end of the sampling period, stop disturbing the substrate and let the water run clear.

Before removing the net, rub any rocks that you used to anchor the net to the stream bottom and remove the rocks from the bottom. Firmly grab the bottom of the net so that your sample does not fall from the net, and then remove it from the water with a forward-scooping motion. This will allow you to remove the net without allowing any insects to be washed under or off it.

Placing a white trash bag or white sheet under the net before separating the sample will catch any tiny organisms that may crawl through the net. Use a watering can or spray bottle to periodically water your net. The organisms will stop moving as the net dries out. Occasionally wetting the net will cause the organisms to move, making them easier to spot. Watering the net is especially important on hot, dry days.

ROCKY BOTTOM SAMPLING EQUIPMENT

- Biological Monitoring Data Form for Rocky Bottom Method
- Kick-seine with 1/32-inch mesh
- Net poles
- Portable table
- White sheet or table cover
- "Field Guide to Aquatic Macroinvertebrates"
- Aquatic thermometer
- Magnifying glass
- Small magnifier boxes (optional)
- Spray bottle
- Ice cube trays or specimen jars for sorting organisms
- Tweezers or forceps
- Clipboard
- Boot-footed waders or waterproof knee boots
- Neoprene gloves, hand, elbow or shoulder length (optional)
- Additional identification resources

Place the net on a flat, bright area, out of direct sunlight. Using tweezers or your fingers, separate all the organisms from the net and place them in your collecting container, which should be full of water from the stream. Sort organisms into similar groups as you separate your sample. This will make your identification quicker when you are ready to record results. Plastic ice cube trays are helpful when sorting the catch. For example, put all organisms with legs in one section and all organisms with no legs in another section. Any organism that moves, even if it looks like a worm, is part of the sample. Look closely, since most aquatic macroinvertebrates are only a fraction of an inch long.

IDENTIFICATION

Once organisms are collected through either the Rocky Bottom or Muddy Bottom Sampling methods, they are sorted and identified. You can use IWLA's "Field Guide to Aquatic Macroinvertebrates" or *A Guide to Aquatic Insects and Crustaceans*, both of which can be purchased through links on the Save Our Streams equipment page on the League's website: *iwla.org/sos*. The League's free Aqua Bugs app provides easy-to-follow instructions to help you identify your macroinvertebrates. Search for it in the Apple Store and Google Play Store.

Izaak Walton League macroinvertebrate guides provide a general overview of the macroinvertebrate types found across the United States. The composition of macroinvertebrate populations varies depending on local geography and geology. Try contacting your local environmental protection agency or universities for more information about local macroinvertebrates. Local experts might be able to share additional field guides that are specifically designed for your area.

Not all organisms in your stream are listed in the guides. For instance, macroinvertebrates such as whirligig beetles, water striders, and predaceous diving beetles are not included on the survey sheet. They are surface breathers and do not provide any indication of water quality.

When beginning your identification, ask yourself the following questions:

- How large is the organism?
- Is the body long and slender, round, or curved?
- Does the organism have any tails? How many?
- Does the organism have any antennae?
- Does the organism have legs? How many? Where?
- Is the body smooth and all one section, or is it segmented (two or more distinct sections)?
- Does the organism have any gills (fluffy or plate-like appendages)?
- Where are the gills located? Sides, back, underside, under its legs?
- Does it have pinching jaws like a beetle larvae?
- Are any legs or antennae missing because they were broken off in the net?
- What color is the organism?
- Does the organism swim underwater or remain on the surface?

When using the macroinvertebrate guides, read the descriptions for each organism. Sizes are provided for reference. However, if you catch a young macroinvertebrate that has just hatched and has not yet reached full size, it may be smaller than indicated in the guides. Specimens can be put into magnifying boxes to ease identification. Return the organisms to the stream after sampling is completed.

METRICS

During identification of macroinvertebrates, record your results on the macroinvertebrate chart. Once you have counted all collected organisms, start calculating the Individual Metrics. Each Individual Metric is a percentage of various macroinvertebrate groups. Tally each indicated organism group and calculate the percentage to determine the Individual Metrics.

Use each Individual Metric to calculate the Multimetric Index Score (stream health score). Write each metric value from the Individual Metrics into the corresponding box under Your Metric Value. Determine the score based on the range for each metric value and indicate which score each Metric Value falls under. Follow the multiplication steps at the bottom of the table to determine your Save Our Streams Multimetric Index Score and determine whether the site has acceptable or unacceptable ecological conditions.

BIOLOGICAL MONITORING DATA FORM QUESTIONS

The Biological Monitoring Data Form also includes questions about the land and vegetation surrounding the stream. These questions help characterize the quality of stream habitat and its ability to support a healthy population of stream organisms. The land use information also paints a picture of the stream for other people who might review your data. Guidelines for correctly answering these questions are given below. Record the answers based on the area that is upstream from your monitoring site; generally, you should record the data for the area you can see. For land use information, include uses for one mile upstream from your site or the section of stream you have adopted. If necessary, take a walk or consult a map for this information.

Fish water quality indicators: Different fish have different tolerances to pollution. The type of fish present may indicate the type of water quality expected. If you collect fish but don't recognize the type, write a description of the fish on the data form or take a picture to use for later reference. You can find fish identification charts or experts to help with fish identification at local schools, agencies, libraries, or online.

Barriers to fish movement: The absence of certain fish types may be due to a dam or other large obstacle, not because of water quality. Note on your survey form if the dam is upstream or downstream from your monitoring site and how far away. Waterfalls should only be recorded if they are large enough that a fish could not reasonably jump over them or swim around them. Usually, waterfalls of a few feet or less are not impediments to the upstream movement of fish.

Surface water appearance: You may check more than one of the colors listed but not all of them. Note if strange colors are present throughout the stream or only in one section, such as immediately below a discharge pipe or highway culvert.

Streambed deposit (bottom): Record the over-all appearance of the stream bottom. If the streambed does not have any apparent coating, you may note it as "other" and write in "normal."

Odor: Note any unusual odors. Odors may come from natural processes or may indicate potential water quality problems.

Stability of streambed: An unstable streambed can mean that soil is eroding from the bottom of the stream and may indicate water quality problems. When standing in the stream, determine how frequently the bed sinks beneath your feet.

Algae appearance: Algae feels slimy. You will notice it as you rub rocks during monitoring. A great deal of algae may indicate too many nutrients in the water. Sometimes more algae will appear in the spring after snowmelt releases extra nutrients into the stream. However, take note of the percent and type of algae present in the stream to make sure it is not increasing over time.

Algae located: Estimate the percentage of stream bed that is covered by algae. Algae is often present in small quantities in healthy streams. Excess algae may indicate water quality problems.

Stream channel shade: Over the course of the day, estimate what percentage of the stream channel is shaded by stream-side trees, shrubs, and grasses. Shading helps keep water cool and can be beneficial for aquatic life.

Streambank composition: Remember to look at both sides of the stream's banks. When questions ask for a percentage, use the information for both the left and right bank and combine values. For instance, if one side of the bank is completely bare due to erosion while the other side is well vegetated, you should record the percent of bank coverage as 50 percent.

When recording total percentages of shrubs, grasses, and trees, you should also look at both sides of the bank. However, if one side has artificial structures such as rock riprap or concrete, you will have to account for such ground cover. For instance, if the left side of the bank is not vegetated, you cannot have more than 50 percent of shrubs, grasses, and trees total when those values are added together.

Streambank erosion: Again, look at both sides of the bank to determine the percentage of soil erosion.

Riffle composition: This question refers to the 3x3-foot area of the stream sampled for Rocky Bottom Sampling techniques with a kick-seine net. Do not fill out this question when using the muddy bottom sampling technique.

If you used a kick-seine to conduct the Rocky Bottom Sampling method, answer this question before you disturb the site. The organisms you collect are most abundant in riffles composed of predominantly cobble-sized stones (more than 70 percent cobbles is a good riffle habitat). Start with the largest rocks first when recording bed composition. If you don't have any boulders (rocks larger than 10 inches), record cobble-sized stones and continue until your percentages equal 100 percent. A typical riffle in a medium-gradient stream might be recorded as 5 percent boulders, 65 percent cobbles, 15 percent gravel, 10 percent sand, and 5 percent silt. Ranges are given on the survey form for the rock sizes. For the smaller rock sizes, remember that silt feels like talcum powder and sand feels gritty. If your riffle had 40 percent silt, 10 percent gravel, and no cobbles, you should either find another station to monitor or switch to the Muddy Bottom Sampling method.

Land uses in the watershed: The survey form asks if land use impacts within a one-mile radius of your sampling site are high (H), moderate (M), slight (S), or none (N). Although these questions are somewhat subjective, determining the impact is easy and straightforward.

- Note "H" for a land use if it:
  - Comprises the majority of land in the watershed and is polluting the stream, such as a stream traveling through land that is being strip mined for coal.

  - Has a severe impact on stream quality even though the land use does not utilize a great deal of land, such as a construction site that has caused the stream to be full of silt.
- Note "M" if the land use is definitely contributing to stream degradation, but is not the major cause for degradation (or is one of many causes). For example, parking lot runoff and trash from a shopping mall may contribute significantly to stream pollution, but they may not be the only causes of stream degradation.
- Note "S" for a land use if its impacts only slightly pollute the stream. For example, although a farm may be present, good farming practices and conservation measures may mean the pollution impact is negligible.
- Note "N" if the land use is present but causing no pollution.
- If the land use is not present, do not write anything.

Take the time to drive or walk through your watershed before filling out this section to determine if these land uses are present and impacting the stream.

When considering land use as the controlling factor in stream quality, look not just at the area visible from the stream but at all the land draining into the stream – the watershed. If the stream collects water from an intensely developed or agricultural area, do not be surprised if no organisms are found. Should this be the case, consider visiting a forested stream of the same size in the same watershed for sampling comparison. You might be surprised by the different types of organisms you find.

You can identify a pollution source by sampling the stream at quarter-mile intervals upstream from the initial sampling point (where a pollution impact is suspected) until quality improves. The pollution sources should be identified somewhere between the point where degraded conditions were first found and the point where water quality improves.

Comments: Use this space to record observations that are not noted elsewhere on the data form. This may include current and potential future threats to the stream's health.

STREAM PROBLEMS AND THEIR EFFECTS ON STREAM ORGANISMS

1. **Physical Problems** may include excessive sediment from erosion, street runoff, or discharge pipes. Sediment can create poor riffle characteristics, contribute to excessive flooding, reduce flow, change water temperature, and smother aquatic life. The result is usually a reduction in the number of macroinvertebrates in the study area.

2. **Organic Pollution** is from excessive human or livestock wastes or high nutrient enrichment from farm or yard runoff. The result is usually a reduction in the diversity of insects.

3. **Toxic Pollution** includes chemical pollutants such as chlorine, acids, metals, pesticides, and oil. The result is usually a reduction in the number of insects.