Save Our Streams Muddy Bottom Sampling Method

Stream Quality Survey Instructions

April 1994

Conducting a stream quality survey can help you determine if your stream is healthy. Accurately filling out the SOS Stream Quality Survey form will help you notice and document changes in stream water quality. You may want to contact local and state agencies first to determine if your state is interested in using your data, if the state is already monitoring your stream, or if there are already volunteer projects underway in which you can participate.

Surveying stream macroinvertebrates, organisms such as insects and crayfish large enough to be seen by the unaided eye, will help you to assess the health of your stream. Many stream dwelling organisms are sensitive to changes in water quality, and their presence or absence can serve as an indicator of environmental conditions. Macroinvertebrates are easy to find. By following the technique below and filling out the SOS Stream Survey, you can diagnose your stream's water quality. Before you choose a site to monitor you should follow these SOS golden 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);
- Review your safety fact sheet, *"Safety and Fun in the River,"* in the SOS Kit and carefully prepare for your river trip; and,
- Always 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 spaced no closer than one quarter-mile. If the stations are spaced more closely, you might monitor your stream so thoroughly that you

become the main impact to water quality. For example, if you want to monitor a one mile segment of a stream, you can have a maximum of four monitoring locations. Be sure to revisit the **same exact station** each time so that your results will be comparable over time.

Carefully record the location of your monitoring station on your SOS Stream Survey form. Include roads, bridges and significant landmarks when noting your monitoring location. If you can locate your station on a topographic map, you should also record your station according to longitude and latitude. That will allow people to locate your station from anywhere in the world and allow you to easily describe your location to government officials. A free catalogue of topographic maps is available from the U.S. Geological Survey (USGS). Write to U.S. Geological Survey, Books and Open File Report Center, P.O. Box 25425, Federal Center, Denver, CO, 80255 or call the USGS Reston Map Center at (703)648-6892.

If you are monitoring more than one station you should begin monitoring downstream and move upstream as you survey each location. This will prevent macroinvertebrates disturbed by your first test from washing downstream and getting caught in your net a second time. Each station survey should record only the organisms present at that particular location and not those disturbed (and counted!) in previous tests.

The Muddy Bottom Sampling Method was written by the Izaak Walton League for use by volunteers involved in sampling streams that do not have rocky bottoms or "riffles", but are instead composed of muddy or sandy substrate, overhanging bank vegetation and submerged woody and organic debris. These instructions are based on methods developed by the Mid-Atlantic Working Group of eastern states. This method was created to enable sampling of streams where kick-seining techniques would not yield the best representative sample or allow easy collection from the most productive aquatic habitats. Field testing of this approach has been carried out by scientists in several east coast and southern states. While the collection techniques are appropriate for muddy-bottom and slow-flowing waters, it should be noted that this approach is relatively new and may be modified over time by SOS staff as further research is conducted.

Monitoring should be conducted four to six times per year at each station you are monitoring. Monitor once each in the spring, summer, winter, and fall and then at two other times. Good "other times" include after floods, oil spills, or other events that could potentially impact water quality. These extra surveys, when compared to your regular seasonal surveys, will help to determine water quality impacts. Monitoring once each season will accurately record the yearly cycle of life in your stream. Less frequent monitoring, while still useful, will not allow you, state biologists, or other persons interested in your stream to get the complete "full picture" of life in your stream.

When scheduling your monitoring events, remember that excessive monitoring can become the major threat to stream health. 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 overmonitor 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 six surveys for the year. The data you collect might be the only data available on the immediate impacts of the spill.

Catching the Macroinvertebrates

Monitoring is conducted using an aquatic D-Frame net with 1/32 inch mesh and a four foot pole. The dip net is used to provide ease of sampling when working in streams and rivers with muddy, sandy or soft bottoms in which a wide variety of habitat must be sampled in order to collect many different kinds of organisms.

Equipment:

One D-Frame aquatic dip net with mesh of 1/32 inch
White enamel or plastic shallow pan
SOS macroinvertebrate identification card and survey sheets
Specimen jars for samples needing additional identification
Fahrenheit thermometer with metal backing
Two small magnifier boxes to aid in specimen identification
Magnifying glass
One screen bottom bucket with a mesh of 1/32 inch for washing specimens (optional)
Tweezers or Forceps (optional)
Ice cube trays for sorting organisms (optional)
Clipboard to write on (optional)

Muddy Bottom Sampling

Your SOS Kit contains instructions for making your own net. Nets can also be purchased (see the *Volunteer Water Monitoring Bibliography* in your SOS Kit).

Before monitoring, you should become familiar with the four main habitats of muddy bottom streams: steep banks/vegetated margins, silty bottom with organic matter, woody debris with organic matter, and sand/rock/gravel/substrate. Look for these habitats in the section of stream in an area up to 50 feet upstream from the monitoring station.

To provide for accuracy of collection and comparability of data from one station to another, scoop the stream a total of 20 times. Each scoop involves a forward motion of one foot. The D-frame net is one foot wide. Thus, one scoop equals one square foot, and you will monitor a total area of 20 square feet.

You should identify the location of the four main habitat types, and then collect the following numbers of scoops from each habitat:

- 10 scoops from steep banks/vegetated margins
- 3 scoops from silty bottom with organic matter
- 4 scoops from woody debris with organic matter
- 3 scoops from sand/rock/gravel/substrate.

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

Steep banks/vegetated margins

This habitat is the area along the bank and the edge of the waterbody consisting of overhanging bank vegetation, plants living along the shoreline, and submerged root mats. Vegetated margins may be home to a diverse assemblage of dragonflies, damselflies, and other organisms. Move the dipnet 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.

Silty bottom with organic matter

Silty substrates with organic matter can be found where the water is slow-moving and where there is overhanging vegetation or other sources of organic matter. These silty substrates harbor burrowing organisms such as dragonflies or burrowing mayflies. Samples are collected by moving the net forward (upstream) with a jabbing motion to dislodge the first few inches or organic layer.

Woody debris with organic matter

Woody debris consists of dead or living trees, roots, limbs, sticks, cypress knees and other submerged organic matter. It is a very important habitat in slow-moving rivers and streams. The wood helps trap organic particles that serve as a food source for the organisms and provides shelter from predators, such as fish.

To collect woody debris, approach the area from downstream and hold the net under the section of wood you wish to sample, such as a submerged log. Rub the surface of the log for a total surface area of one foot. It is also good to dislodge some of the bark as organisms may be hiding underneath. You can also collect sticks, leaf litter, and rub roots attached to submerged logs. Be sure to thoroughly examine any small sticks you collect with your net before discarding them. There may be caddisflies, stoneflies, riffle beetles, and midges attached to the bark.

Sand/rock/gravel/substrate

In slow moving streams, bottoms are generally composed of only sand or mud because the velocity of the water is not fast enough to transport large rocks. Large rocks provide the most productive habitat. Sometimes, you may find a gravel bar located at a bend in the river. An area of the stream where the water is bubbling over the rocks is called the riffle. The bottom can be sampled by moving the net forward (upstream) with a jabbing motion to dislodge the first few inches of gravel, sand, or rocks. You may want to gently wash the gravel in your screen bottom bucket and then discard gravel in the river.

If you have large rocks (greater than two inches diameter) you should also kick the bottom upstream of the net to dislodge any borrowing organisms. Remember to disturb only one foot upstream of the net for each collection.

Each time you sample you should sweep the mesh bottom of the D-Frame net back and forth through the water (not allowing water to run over the top of the net) to rinse fine silt from the net. This will avoid a large amount of sediment and silt from collecting in the pan and clouding your sample.

After collecting your samples, dump the net into a shallow white pan filled with a few inches of river water. You should dump your debris into your pan of

water after every three scoops to avoid clogging the net. Dumping your net periodically will also prevent you from having to sort a great deal of debris all at once. Collect organisms from your pan and place like organisms in ice cube trays for identification.

You may also want to sort your insects into look-alike groups as you pick them. This will make your identification quicker when you are ready to record results on your survey form. You can use plastic ice cube trays to do this. For example, put all organisms with legs in one section and all organisms with no legs in another section, etc.

Identification

Once organisms are collected, they are sorted and identified using the Save Our Streams Insects and Crustaceans Card. It is important to note that not all organisms you may find in your stream are listed on the card. 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 the dissolved oxygen content of the water.

Specimens can be put into magnifier boxes to ease identification. Use characteristics such as body shape, number of legs, tails and antennae, size, color, swimming movement, and gill locations to identify organisms. When using the bug card, remember to read the descriptions for each organism. Also remember that the lines on the bug card indicate the sizes of the organisms. However, if you catch a young macroinvertebrate that has just hatched and has not yet reached full size, it may be smaller than indicated on the bug card.

To identify the organisms use body shape, size and other characteristics (number of legs and tails), since the same family can vary in size and color (Refer to the SOS bug card and the *SOS booklet, Stream Monitor's Guide to Aquatic Macroinvertebrates*). Volunteers can also call the toll-free help line at the IWLA (1-800-Bug-IWLA).

Ask yourself the following questions to identify an organism:

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

After identifying your organisms, record your results on the SOS Stream Quality Survey sheet. Specimens are returned to the stream after sampling is completed. The SOS survey also includes information relating to habitat and physi-

cal parameters of the stream. Tabulate your results to determine the water quality using the instructions on the survey sheet. Use letters to indicate the number of each type of organism (A = 1 - 9, B = 10 - 99, C = 100 or more). Add the number of letters in a column and multiply by the index value at the bottom of the column. Add the subtotal for each column to arrive at your final stream rating.

You will notice that the letter (A, B or C) does not affect the final rating score of excellent, good, fair or poor. This is because the SOS survey is based primarily on diversity, not the number of individual organisms found. The letters are valuable, however, because they document changes in populations over time. For instance, your spring survey has only C's in the pollution sensitive column and only A's in the pollution tolerant category. In your next survey, you find only A's in the sensitive range and C's in the tolerant range. You might conclude that overall water quality was becoming poorer because populations of the tolerant organisms are increasing (A to C) while those in the sensitive category are decreasing (C to A). You should monitor for an entire year to get a clear picture of your stream and consult with state biologists from your water regulatory agency to discuss your findings.

Studying the Find

You may want to check another spot about a quarter mile upstream. If you find a decrease in water quality, check the stream for new discharge pipes, evidence of erosion, farm runoff, and other possible sources of stream pollution.

Macroinvertebrate Count and Water Quality

If you find:	Look for:
Little variety of insects, with great abundance of each kind	Water overly enriched with organic matter
Only one or two kinds of insects in great abundance	Severe organic pollution
A variety of insects, but only a few of each kind, **or** no insects, but the stream appears clean	Toxic pollution

Stream Problems and Their Impact on Stream Organisms

1. **PHYSICAL PROBLEMS** may include excessive sediment from erosion, street runoff, or a discharge pipe. Sediment may: create poor riffle characteristics; contribute to excessive flooding; reduce flow; change temperature; and smother aquatic life. The result is usually a reduction in the number of all animals 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 number of different kinds of insects, leaving more collectors/scrapers (such as the caddisflies).

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.

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 to the stream - the watershed. The SOS publication, *Understanding Your Watershed*, describes the procedure for defining the watershed area. If the stream drains an intensely developed area, do not be surprised if no organisms are found. Should this be the case, consider visiting a forested or agricultural stream for a sampling comparison. You may be surprised at the different types or organisms you find.

Pollution sources causing poor or fair stream quality include sewage treatment plants, industries, construction sites, sewer overflows, landfills, and mining operations. A pollution source can be identified by sampling the stream at one quarter mile intervals upstream from the initial sampling point (where a pollution impact is suspected) until quality improves. The pollution sources should be located somewhere between the point where degraded conditions were first found and the point where water quality improves.

Explanation of Survey Form Questions

The SOS survey form asks a number of questions about the land and vegetation surrounding the stream. These questions will help you characterize the quality of stream habitat and its ability to support a healthy population of stream organisms. The land use information will also paint a picture of your stream for other people who might review your survey form. Guidelines for correctly answering these questions are given below. Questions where the answer is obvious are not explained. You should record answers based on the area that is upstream from your monitoring site. Generally, you should record the data for the area that you can see. For land use information, include land uses for one mile upstream from your site or the section of stream you have adopted (ie. one quarter mile).

Fish indicators: The survey form asks if fish are present. Different fish have different tolerances to pollution. The type of fish present may indicate the type of water quality expected. You should not include fish that are stocked and do not survive through the winter or do not successfully reproduce from year to year. For example, trout are pollution sensitive fish, but the presence of trout is not a good water quality indicator if the fish are stocked by a state sport fishing program and only live for a few weeks.

The question concerning ***barriers to fish movement*** is important to consider because the absence of certain fish types in your stream section may be due to a dam or other large impoundment, not because of the water quality. Note on your survey form if the dam(s) is upstream or downstream and the distance(s) from your survey site. 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 upstream movement of fish.

Surface Water Appearance: You can 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 runoff culvert.

Stream Bed Deposits: Record the general overall appearance of the stream bottom. If the stream bed does not have any apparent coating you may note it as *other* and write in "normal."

Questions about stream banks and vegetation: 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 from erosion while the other side is well-vegetated, you should record the percent of bank coverage as 50% (one half is covered and the other is not).

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 rip rap 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% of shrubs, grasses and trees total when you add those values together.

Riffle composition: This question refers to the 3 x 3 foot area of stream sampled for rocky bottom sampling techniques with a kick-seine net. You do not have to fill out this question when using the muddy bottom sampling technique. Simply check off the number of scoops taken from each of the four types of muddy bottom stream habitats found in the next question on the survey form (muddy bottom only).

Algae: Algae feels slimy and you will notice it as you rub rocks during monitoring. A great deal of algae may indicate a nutrient enrichment problem. Sometimes you will find more algae in the Spring after snowmelt releases extra nutrients to the stream. However, you will want to notice the percent and type of algae present in your stream to make sure it is not increasing over time.

Land Uses in the Watershed: The SOS Survey form asks if land use impacts 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 strip-mined land. Mark "H" if the land use 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 which has caused the stream to be full of silt and muddy water. 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 may not be the only cause of stream degradation. Note "S" for a land use if its impacts are slight in polluting the stream. For example, although a farm may be present, good farming practices and conservation measures may mean the pollution impact is negligible. If the land use is present, but causing no pollution, write "N" for none. If the land use is not present **do not write anything.** Also, you should take the time to drive or walk your watershed before filling out this section to determine if these land uses are present and impacting the stream.