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Voluntary Estuary Monitoring Manual

Chapter 7: In the Field

March 2006

Chapter 7
In the Field

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Photos (l to r): Weeks Bay Watershed Project, U.S. Environmental Protection Agency, E. Ely, K. Register

Overview

Being in the estuarine environment has great appeal for many volunteers. The key for any program leader is to maintain volunteer interest while ensuring the quality of data. To meet these goals, the program leader must recognize that several elements go into the collection of estuary data. Failure to consider these elements can cause problems for volunteers and program managers.

Previous chapters discussed planning a volunteer monitoring program, establishing a quality assurance project plan, and general sampling considerations. This chapter reviews several topics applicable when volunteers travel into the estuary to collect and analyze samples. It includes discussions of safety, supplies and equipment, locating the sampling site, making observations about the site, collecting data, and completing the data collection form.

Fun in the Field

As discussed in Chapter 4, volunteers have different reasons for getting involved with an estuary monitoring program. One common motive is the opportunity to be outside, on the water, helping the estuary. Many volunteers look forward to going, as scientists say, "into the field" to collect and analyze water samples. For them, being in the field is an enjoyable experience.

While being in the field is more often than not an entertaining experience for all involved, volunteer leaders need to be aware of several potential pitfalls. Sampling errors can compromise data quality. Disappointed or angry volunteers can return, after hours of mucking around, with no data because they discovered too late that their equipment was not operating properly. Data interpretation may be hampered because volunteers fail to complete data forms properly. Volunteer injuries, while uncommon, must always be in the back of every leader's mind.

With proper planning and training, the monitoring leader can avoid these problems. A bit of forethought before sending volunteers to monitoring sites can ensure volunteer safety, data quality, and fun in the field. ■

Preliminary Steps for Field Sampling

The following steps generally apply when monitoring most estuary water quality variables. Elaboration on these steps is provided throughout this chapter. These are not the only necessary steps, however. Additional steps should be taken for each water quality parameter. Refer to each respective chapter for details.

STEP 1: *Prepare for the field*

Before proceeding to the monitoring site, the volunteer should confirm sampling date and time, understand safety precautions, check weather conditions and verify directions to the monitoring site.

STEP 2: *Check equipment*

The volunteer should also ensure that all necessary personal gear and sampling equipment are present and in working order. Results may be inaccurate if the volunteer has to improvise because a sampling device or chemical bottle has been left behind.

STEP 3: *Confirm proper sampling location*

The volunteer should have specific directions for locating a sampling site. If unsure whether he or she is in the correct spot, the volunteer should record a detailed description of where the sample was taken so that it can be compared to the intended site later.

STEP 4: *Record preliminary observations and field measurements*

The volunteer should record general field observations and measurements (e.g., potential pollution sources, indicators of pollution, presence and apparent health of wild and domestic animals, water color, debris or oil, algal blooms, air temperature, weather conditions, etc.) once at the site. This information is valuable when it comes time to interpret your results.

Record any condition or situation that seems unusual. Descriptive notes should be as detailed as possible.

Before Leaving Home

Chapter 4 detailed volunteer training, emphasizing safety, proper monitoring techniques, and quality assurance/quality control procedures. No volunteer should begin monitoring until properly trained.

Before heading out to sample for the first time, the volunteer should select a sampling timetable that fits into his or her personal schedule. Adherence to the sampling schedule is ideal, but program managers should recognize that occasionally scheduled sampling days and times will be missed due to weather, illness, holidays, vacations, etc. If possible, a makeup date should be arranged within two days on either side of the original date or a trained backup volunteer should substitute for an unavailable volunteer.

The volunteer should confirm the sampling date and time with the program manager and laboratory (if samples are being sent for lab analysis) each time before going out to collect samples. This is especially true if the samples need to be analyzed in a laboratory within a particular timeframe.

The volunteer, in collaboration with the program manager, should also characterize the collection site with a written description, map, and accompanying photograph. This information serves as an initial status report with which to compare any future changes of the site. Use a global positioning system unit, nautical map, or topographic map to determine the latitude and longitude of the site. Maps and photographs may be available for your area (see Appendix C). ■

Safety Considerations

Safety is one of the most critical considerations for a volunteer monitoring program and can never be overemphasized. All volunteers should be trained in safety procedures and should carry with them a set of safety instructions and the phone number of their program coordinator or team leader.

The following are some basic commonsense safety rules for volunteers:

- Develop a safety plan. Find out the location and telephone number of the nearest telephone and write it down, or have a cellular phone available. Locate the nearest medical center and write down directions for guiding emergency personnel from the center to your site(s). Have each member of the sampling team complete a medical form that includes emergency contacts, insurance information, and relevant health information such as allergies, diabetes, epilepsy, etc.
- Listen to weather reports. Never go sampling if severe weather or high waves are predicted or if a storm occurs while at the site. Training should include information on the appropriate circumstances for both proceeding with and waiving data collection. If volunteers elect to go out in poor conditions, they should be aware of the risks and always take proper safety gear (particularly if proceeding by boat). No one should go out on the water during thunderstorms or high wave conditions.
- Always monitor with at least one partner (teams of three or four are best). Let someone know where you will be, when you plan to return, and what to do if you don’t return at the designated time.

- Have a first aid kit handy (see box, page 7-5). Know any important medical health conditions of volunteers (e.g., heart conditions or allergic reactions to bee stings). It is best if at least one team member has current first aid/CPR training.
- Dress properly. In cold weather, bring layered clothing, gloves, and boots. In warm weather, dress to avoid sunburn, insects, jellyfish, and brambles. Always bring goggles and latex gloves (or some alternative gloves for those allergic to latex). Wear hunter's orange during hunting season.
- Bring water and snacks.
- If you drive, park in a safe location. Be sure your car doesn't pose a hazard to other drivers and that you don't block traffic.
- Put your wallet and keys in a safe place, such as a floatable, watertight bag that can be kept in a pouch strapped to your waist.
- Never cross private property without the permission of the landowner. A better option, depending on the project's objectives, might be to sample at public access points (e.g., public parks). Take along a card identifying you as a volunteer monitor.
- Watch for irate dogs, farm animals, and wildlife (particularly snakes, ticks, hornets, and wasps). Know what to do if you get bitten or stung.
- Watch for poison ivy, poison oak, sumac, and other types of vegetation in your area that can cause rashes and irritation.
- Do not walk on unstable riverbanks. Disturbing these banks can accelerate erosion and might prove dangerous if the bank collapses. Do not disturb vegetation on the banks.
- Be very careful when walking in the estuary itself. Rocky-bottom areas can be very slippery and soft-bottom areas may prove treacherous in areas where mud, silt, or sand have accumulated in sinkholes. Your partner(s) should wait on dry land, ready to assist you if you fall. Wear waders and rubber gloves at sites suspected of having significant pollution problems.
- Never wade in swift or high water.
- Confirm that you are at the proper site by checking maps, site descriptions, directions, or a global positioning system.
- Do not monitor if the site is posted as unsafe for body contact. If the water appears to be severely polluted, contact your program coordinator.
- Pay attention to the tidal stage. Don't get trapped by rising or falling tides.
- If you are sampling from a bridge, be wary of passing traffic. Wear bright orange safety vests and hats and set out orange traffic cones. Never lean over bridge rails unless you are firmly anchored to the ground or the bridge with good hand/foot holds.
- Wash your hands with antibacterial soap after monitoring. Eat nothing until you have washed your hands.
- If you are using a boat, ensure that hulls, engines, equipment, and trailers are inspected and in good working order.
- **If at any time you feel uncomfortable about the condition of the monitoring site or your surroundings, immediately stop monitoring and leave the site. Your safety is more important than the data!**

When using chemicals:

- Know your equipment, sampling instructions, and procedures before going out into the field. Prepare labels and clean equipment before you get started.
- Keep the sampling equipment clean before and after each use.
- Keep all equipment and chemicals away from small children and animals. Many of the chemicals used in monitoring are poisonous. Tape the phone number of the local poison control center to your sampling kit.
- Avoid contact between chemical reagents and skin, eye, nose, and mouth. Never use your fingers to stopper a bottle (e.g., when you are shaking a solution). Wear safety goggles and gloves when performing any chemical test or handling preservatives.
- Know how to use and store chemicals. Do not expose chemicals or equipment to temperature extremes or long-term direct sunlight (see "Getting the Most Out of Reagents," page 7-6).
- Any work surface should be kept clean of chemicals and sponged with clean water after the test is complete.
- Know chemical cleanup and disposal procedures. Wipe up all spills when they occur. Return all unused chemicals to your program coordinator for safe disposal. Close all containers tightly after use. Do not put the cap of one reagent onto the bottle of another. Dispose of waste materials and spent chemicals properly (see box, page 7-8).
- When working with bacteria samples, wash your hands between samples and when you are finished with testing. Avoid contact with bacterial colonies after they have been incubated (Stancioff, 1996). ■

First Aid

At a minimum, a first aid kit should contain the following items:

- Telephone numbers of emergency personnel (e.g., police, ambulance service)
- First aid manual which outlines diagnosis and treatment procedures
- Antibacterial or alcohol wipes
- First aid cream or ointment
- Acetaminophen for relieving pain and reducing fever
- Several band-aids
- Several gauze pads 3 or 4 inches square
- 2-inch roll of gauze bandage
- Triangular bandage
- Large compress bandage
- 3-inch wide elastic bandage
- Needle for removing splinters
- Tweezers for removing ticks
- Single-edged razor blade
- Snakebite kit
- Doctor-prescribed antihistamine of participant who is allergic to bee stings

Be sure to carry emergency telephone numbers and medical information for everyone participating in field work (including the leader) in case of emergency.

(Excerpted and adapted from USEPA, 1997.)

Getting the Most Out of Reagents

Most volunteer monitoring programs use chemicals called **reagents** to help analyze water samples. Because the reagents are chemically reactive, they can easily degrade. Test reagents are also very susceptible to contamination under field conditions.

Replacing degraded reagents results in additional expense for the monitoring program. If bad reagents are not discovered in time, their use can also lead to erroneous water quality measurements and disappointed volunteers whose hard work in the field is wasted. It is therefore wise—financially and programmatically—to check reagent quality and extend their useful life whenever possible.

Reagent Enemies

Temperature

In general, the speed of a chemical reaction doubles with every 10°C increase in temperature. Since reagent decomposition occurs by means of chemical reactions, high temperatures will speed decomposition.

Sunlight

Many reagents will decompose when exposed to direct sunlight. Reagents containing silver—commonly found in kits that use a titration method to test chloride or salinity—are especially sensitive to sunlight and will turn black when decomposition occurs due to sunlight exposure. This reagent is supplied in an amber glass, amber plastic, or other opaque plastic container to protect it from sunlight.

Air

Evaporation can concentrate reagents, a condition which is especially critical for a titrant. Many reagents can also react chemically with oxygen or carbon dioxide in the air.

Contamination

Any foreign material introduced into a reagent bottle can cause test results to be in error. Mold or algae can grow in starch reagents. Other common sources of contamination are inadequate cleaning of equipment that is used to analyze more than one sample and failure to use a dedicated dropper for each reagent.

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(Getting the Most . . .continued)

Recognizing Bad Reagents

One of the easiest ways to tell if a reagent has gone bad is by its appearance. Note the reagent's color when you first receive it. Over time, look for any changes in color or clarity, or for formation of solids (e.g., a crust on the lip of the bottle, floating particles, or solids settled at the bottom).

If you suspect that a reagent has gone bad, you can test it by using a standard (a solution of known pollutant concentration). Standards can be purchased from test kit manufacturers or other chemical companies, or obtained from cooperative laboratories. Most reagents will also have expiration dates printed on their containers.

You can also test your reagents by checking the suspect test kit against another kit that has fresh reagents, or by cross-checking the kit against another method, such as a meter.

Preventing Degradation

There are many steps you can take in the field to get the most use out of reagents:

- Keep reagent bottles inside test kit during storage.
- Store kits away from heat and sunlight (this includes car trunks!).
- Minimize the amount of reagent exposure to heat and sunlight during testing.
- Do not leave reagent containers open any longer than necessary when performing tests.
- Be sure to place sunlight-sensitive reagents in opaque bottles when replacing or refilling them.
- Keep reagent bottles tightly capped.
- Use dedicated droppers and dedicated equipment whenever possible.
- Always bring a container to the field for washing equipment between tests.
- Keep reagents in a refrigerator that is not used to store food.

Of course, check expiration dates and replace reagents before they expire.

(Excerpted from McAninch, 1997.)

Dealing with Waste

Waste Liquids:

Many water quality monitoring kits produce waste liquids that you cannot pour into the estuary. Read the “Material Safety Data Sheet” that comes with your monitoring equipment for specific disposal procedures. Here is one method used to dispose of waste liquids:

- Pour all waste liquids into a separate container, such as a bottle or jug with a screw cap. **Beverage containers should not be used for this purpose, since the contents could be mistaken for a beverage. Containers into which liquid wastes are poured should be clearly labeled with appropriate warnings.** It is usually acceptable to mix the waste from all your field tests, but confirm this by reading the “Material Safety Data Sheet” that comes with the monitoring equipment.
- Take the waste container home (don’t dump it outside).
- At home, add kitty litter to the container, cap it tightly, and put it out with the trash.

Some manufacturers’ Material Safety Data Sheets will tell monitors to dilute waste liquids and pour them down the drain if the monitors’ homes are served by centralized wastewater treatment systems. It is recommended that volunteer leaders contact their local wastewater management agency to get exact instructions. It is important to tell the wastewater management agency the names of each chemical used. Never put the waste liquids down the drain if you have a septic system, and never dispose of mercury from a broken thermometer by pouring it down any drain. Many volunteer programs avoid this potential problem by using alcohol thermometers.

Bacteria Cultures:

After counting the colonies that have grown in petri dishes, two methods to safely destroy the bacteria cultures are:

Autoclave

Place all petri dishes in a container in an autoclave. Heat for 15 to 18 minutes at 121^{o}C and at a pressure of 15 pounds per square inch. Throw away the petri dishes.

Bleach

Disinfection with bleach should be done in a well-ventilated area, since it can react with organic matter to produce toxic and irritating fumes. Pour a 10-25 percent bleach solution into each petri dish. Let the petri dishes stand overnight. Place all petri dishes in a sealed plastic bag and throw away.

What to Bring

Much of the equipment a volunteer will need in the field is easily obtained from either hardware stores or scientific supply houses. Other equipment can be found around the house. In either case, the volunteer program should clearly specify the equipment its volunteers will need and where it should be obtained.

Listed below are some basic supplies appropriate for any volunteer field activity. Much of this equipment is optional but will enhance the volunteers' safety and effectiveness.

Safety and Health Supplies

- rubber gloves to guard against contamination (warning: some people are allergic to latex; ask volunteers if they are allergic);
- eye protection;
- insect repellent;
- sunblock;
- small first aid kit (see box, page 7-5);
- flashlight and extra batteries;
- whistle to summon help in emergencies;
- cellular phone;
- refreshments and drinking water;
- personal identification (e.g., driver's license);
- compass or Global Positioning System receiver; and
- information sheet with safety instructions, site location information, and numbers to call in emergencies (heavily laminated or printed on waterproof "write in rain" paper, if possible).

Clothing

- boots or waders;
- hat;
- foul/cold weather gear;
- extra pair of socks;
- sweater or other warm clothing;
- all-weather footwear; and
- bright-colored snag- and thorn-resistant clothes (long sleeves and pants are best).

Sampling Gear

- sampling equipment—properly calibrated and checked for accuracy—appropriate for the parameter(s) being measured (may include meters, test kits, etc.);
- water sampler (see "How to Collect Samples" in this chapter);
- sample containers;
- sufficient supply of reagents;
- instruction manual(s) for operating sampling equipment;
- field data sheets (printed on waterproof "write in rain" paper, if possible);
- clipboard, preferably with plastic cover;
- several pencils (ink runs when it gets wet; soft pencils will write on damp surfaces);
- black indelible ink pens and markers;
- map or photograph of sampling location(s);
- compass or global positioning system to help find sampling location(s);
- tide chart;
- cooler and ice (blue ice pack preferably);
- tape measure;
- armored thermometer (non-mercury preferred);
- wash bottles with distilled or deionized water for rinsing equipment;
- containers for waste materials (e.g., used reagents);
- camera and film, to document particular conditions;

- extra rope/line;
- duct tape, electrical tape, zip ties, sealable plastic bags, and other items for quick repair and modification of equipment; and
- walking stick of known length for balance, probing, and measuring.

If monitoring from a boat, volunteers should bring the following additional equipment:

- one U.S. Coast Guard-approved personal flotation device for each person aboard (it is recommended that you wear a life jacket at all times);
- equipment required by state and local law (your state boating administration will have a list, which usually includes such items as a fire extinguisher and bell);
- anchor;
- weighted line to measure depth; and
- nautical chart of area.

Helpful Hint

Personal journals kept by volunteers can be valuable supplements to the information recorded on data sheets. Volunteer notes on field observations and sampling activities can give feedback on sampling methods, aid data interpretation, and provide a useful historic record to accompany the data. In addition, their insights can help future volunteers understand specific nuances of their monitoring sites.

The tools, equipment, instruments, and forms that you take into the field will often depend on where you are monitoring, your monitoring techniques, and the parameters you are measuring. Additional equipment needed for specific chemical, physical, and biological monitoring procedures included in this manual are provided in the relevant chapters. ■

Locating Monitoring Sites, or How Do I Get There from Here?

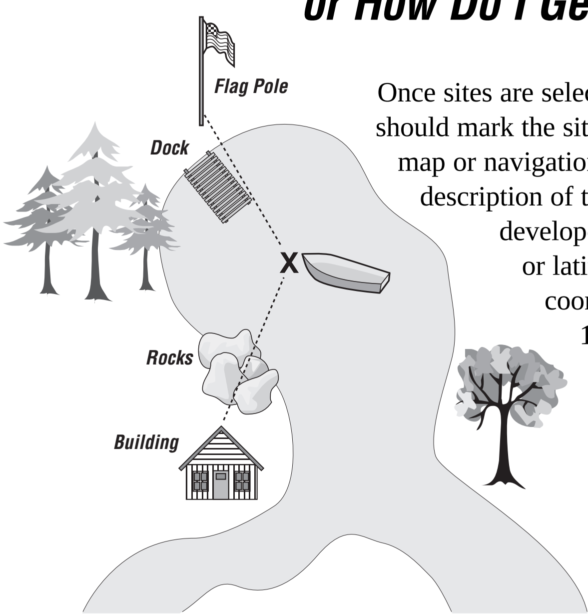

Figure 7-1. The shoreline landmark method.

Once sites are selected, the manager should mark the sites on a topographic map or navigational chart. A written description of the sites should be developed, using landmarks or latitude and longitude coordinates (Stancioff, 1996). Photographs of the sites can also be useful to volunteers.

The manager may also want to create a map showing the location of volunteers' homes if the program relies on citizens sampling from their own dock or pier. This map will illustrate which areas of the estuary still need coverage and where sites may be too tightly clustered.

Returning to the Same Monitoring Sites

Once the program manager and volunteers have chosen monitoring sites, quality control demands that each volunteer sample from exactly the same location each time. If the site is off the end of a dock or pier, returning to the monitoring site is a simple matter. If, however, the volunteer reaches the site by boat, the task becomes more complicated. Some basic methods to ensure that volunteers return to the same site are:

The Shoreline Landmark Method

Landmarks—conspicuous natural or manmade objects—provide a ready means of identifying a specific monitoring site. Once the program manager and volunteer have identified a permanent site, they should anchor the boat and scan the landscape for distinctive features. Such features can include tall or solitary trees, large rocks, water towers, flag poles, or any other highly visible and identifiable object.

Two landmarks, in front-to-back alignment, should be chosen. The sight line created by the landmarks will lead directly back to the site. The volunteer should then pick another set of aligned landmarks onshore about 90 degrees from the sight line of the first set. The two sight or bearing lines should intersect at the boat (Figure 7-1). The volunteer should practice repositioning the boat at this point.

In some cases, volunteers must return to monitoring sites on a coastal pond, sound, or lagoon located in the middle of a salt marsh or in some other rather featureless landscape. If no obvious landmarks are available, volunteers may want to post two sets of brightly colored signal flags (Figure 7-2). They should obtain permission from the landowner before posting the flags.

The Marker Buoy Method

In wind- and wave-protected sections of an estuary, volunteers may want to set buoys to mark the monitoring site (Figure 7-3). The buoy should be brightly colored and easily distinguishable from fishing buoys floating in the area. The program manager should check on local and state regulations regarding buoy placement before using this method.

Although a simple means of marking a site, buoys do not always stay in place; wind, waves, and passersby may move the buoy or remove it entirely. Volunteers should use the shoreline landmark method as a backup to ensure that the buoy is correctly positioned.

Global Positioning System (GPS)

In many cases, the lack of a definitive landmark (e.g., a pier, outfall pipe, or marker buoy) can hinder volunteers from reaching the right sampling location. In addition, monitoring groups using certain data management systems (e.g., Geographic Information Systems; see Chapter 8) may need to report specific geographic locations, often by latitude and longitude. In such cases, reporting a location as "across the street from the firehouse" is unacceptable.

While latitude and longitude can be estimated from a U.S. Geological Survey topographic map, volunteers might still be guessing about their exact position. The most accurate method for determining position is using a Global Positioning System (GPS) receiver. This tool helps to ensure that the volunteer is collecting samples at the same location time after time. As a result, quality control is maintained.

GPS uses a network of satellites to provide users with, among other things, data about their positions on Earth. With relative ease, users can locate their latitude, longitude, and elevation (although elevation is usually less accurate). The volunteer must be sure to minimize the blocking of satellite transmissions by holding the receiver away from the body. Buildings or trees can also cause interference.

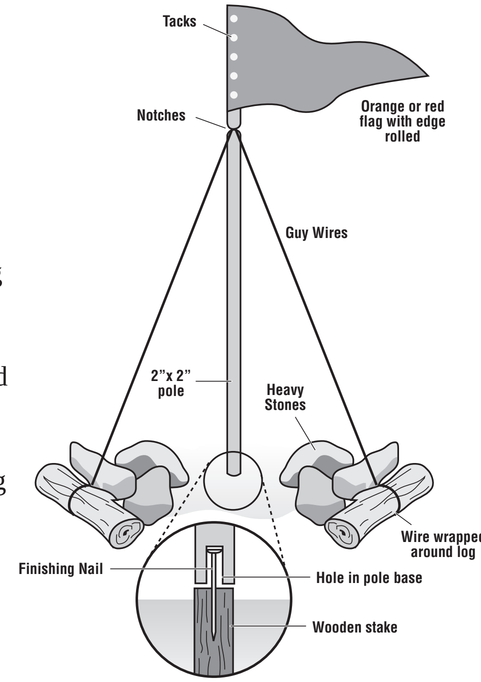

Figure 7-2. Construction of a landmark flag *(adapted from Compton, 1962).*

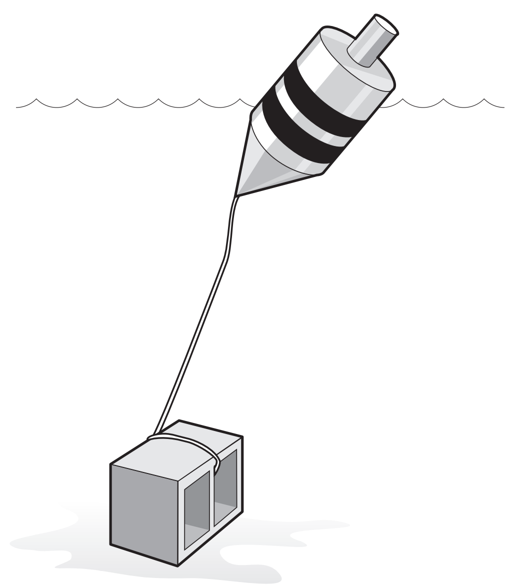

Figure 7-3. The marker buoy. This instrument may be used to identify monitoring sites in sheltered areas of the estuary.

A variety of GPS receivers exist. Generally, as a receiver's accuracy increases, so does its cost. For example, a GPS unit with a differential antenna can be very accurate, but it tends to be more expensive than a unit without the antenna. ■

Helpful Hint

Accurate GPS receivers can be expensive, but volunteer groups do not always have to buy them. Some government agencies loan them out and some GPS receivers can be donated. A monitoring group may be able to borrow a receiver to help pinpoint a sampling location. Once at the location, they can place a marker to ensure that they can easily return to the site.

Making Field Observations: Visual Assessments

Usually, taking a water sample to obtain a water quality variable concentration is not enough; in fact, it is only part of what is needed. Once at the monitoring location, volunteers should take a **visual assessment**, which is simply observing and recording the environmental conditions at the site. Volunteers should always be on the lookout for environmental clues that might help explain the data. A visual assessment of the monitoring site can provide invaluable information and make interpretation of other data easier and more meaningful. For example, if dead fish are floating at the water surface, they may signal a sudden drop in dissolved oxygen (DO) levels, the influx of some toxic substance, or disease or infestation of the fish. Unusual visual data are like bait; they should lure you in for further investigation.

The most value is gained when volunteers assess the same area each time they collect samples. In this way, **the volunteers will become the local experts**—growing familiar with baseline estuary conditions and land and water uses, and being better able to identify changes over time (USEPA, 1997).

When making a visual assessment of the site, look for and record information about:

Potential Pollution Sources

Several programs have started shoreline or watershed assessment projects to characterize land uses and land use changes around an estuary. An assessment can quantify the amount of—and changes in—residential, industrial, urban, agricultural, and forested areas within a watershed. A broader-scope project could further map the location of construction sites, marinas, industrial and municipal discharges, stormwater discharge points, landfills, agricultural feedlots, and any other potential pollution sources to the estuary.

Such an undertaking also provides the program leaders with information that may prove useful in selecting additional monitoring sites.

Indicators of Pollution

Water pollution may not be visually apparent, so other clues can serve as warning of possible contamination. Lesions on fish, for example, suggest the possible presence of toxic contaminants. Surface foam and scum downstream from a plant's discharge could be cause for concern. Although the discharge could lie within legal limits, a citizen group may want to investigate the situation further. Other pollutant indicators include large numbers of dead fish or other animals, rust-colored oozes, large quantities of floatable debris, and highly turbid water.

Record all unusual conditions on a data sheet. Descriptive notes should be as detailed as possible. Volunteers should bring such conditions to the attention of the program leaders so that they can report them to the appropriate authority, if warranted. Monitoring groups which function as watchdogs may want to follow up with an investigation of their own.

Living Resources

A simple assessment of the quantity and type of living resources can round out the set of data taken at one site. Numbers of waterfowl, schools of fish, presence or absence of submerged aquatic vegetation beds, change in shoreline vegetation, and other information relate directly to the area's water quality. Fish kills or widespread shellfish bed die-offs may indicate episodes of intolerable water quality conditions. The presence of birds, pets, sea lions, and cattle may help explain high bacteria concentrations.

Remember, however, that the presence or absence of a living resource does not definitively speak to the estuary's water quality. Many animals are migratory and will not be seen at certain times of the year. Others may remain year-round, but become inactive at times and are difficult to find.

Color

We tend to think of pure water as blue, yet few waterbodies north of the sub-tropics fit this description. Clean water may have a color depending upon the water source and its content of dissolved and suspended materials. Plankton, plant pigments, metallic ions, and pollutants can all color water (Table 7-1). Even the color of the substrate can cause the water to take on an apparent color. To assess color, use one of the established color scales such as the Borger Color System or the Forel-Ule Color Scale from scientific supply houses.

Table 7-1. Water colors and their possible causes.

Apparent Color	Possible Reason
Peacock blue	Light-colored substrate
Green	Phytoplankton
Yellow/Brown	Peat, dissolved organics
Red/Yellow/Mahogany	Algae, dinoflagellates
Myriad colors	Soil erosion
Rainbow	Oil slick

Oil Slicks

Oil slicks are easily recognized by their iridescent sheen and often noxious odor. Oil may indicate anything from a worrisome oil spill to bilge water pumped from a nearby boat. Estimate the size of the slick, if possible, and report any spill to local authorities or the U.S. Coast Guard's National Response Center (1-800-424-8802).

Weather Conditions

The weather, recorded at the time of sampling and for several days beforehand, helps in the interpretation of other data.

Water Surface Conditions

Whether calm, rippled, or with waves and whitecaps, surface water conditions indicate how much mixing is occurring in the top layer of the estuary. When the surface is placid, very little wind-induced mixing occurs. Waves whipped up by wind, however, indicate substantial mixing and the introduction of oxygen to the water. This information may be especially helpful in interpreting dissolved oxygen data.

Ice

Ice cover can affect dissolved oxygen levels in the water by limiting the interaction of water with the atmosphere. In addition, ice in shallow areas may damage submerged aquatic plants and temporarily deprive estuarine animals and waterfowl of their habitat.

Erosion

Evidence of recent erosion, such as a steeply cut bank, may indicate recent storm activity or substantial wakes from boats. In either case, highly turbid water may accompany the erosion. ■

Helpful Field Measurements

Volunteer monitoring programs should consider including several other parameters in their suite of regular measurements. Most are simple to carry out and provide additional background information helpful in the final analysis of an estuary's status. These parameters include:

Air Temperature

Air temperature can be measured with the same meter or thermometer used for reading water temperature. Prior to placing the instrument in the water sample, allow the thermometer to equilibrate with the surrounding air temperature for three to five minutes; a wet thermometer will give an erroneous air temperature reading. Make sure the thermometer is out of direct sunlight to avoid a false high reading.

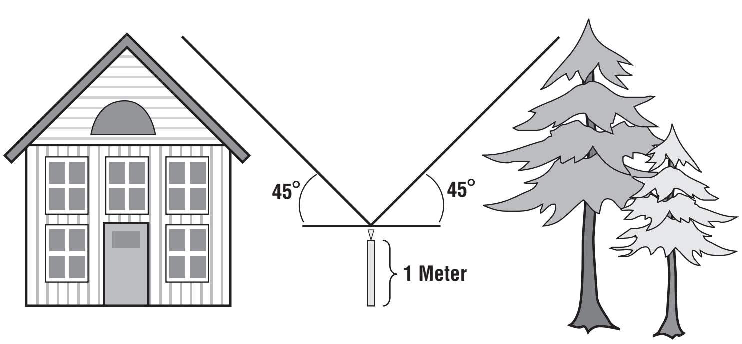

Figure 7-4. Rain gauge placement *(adapted from Campbell and Wildberger, 1992).*

Odor

Though quite subjective, water odor can reveal water quality problems that may not be visually apparent. Industrial and municipal effluents, rotting organic matter and phytoplankton blooms, and bacteria can all produce distinctive odors. Raw sewage, for example, has an unmistakable aroma. Make note of the odor in the data record and describe the smell.

Precipitation

Precipitation data help the program manager determine the possible causes of turbidity and erosion. Turbidity, for instance, generally rises during and after a rainstorm due to soil runoff. A wind storm (without precipitation), on the other hand, might cause turbidity due to bottom mixing. Precipitation also may help explain why nutrient concentrations rise (with rain) or decline (with little rain).

Be sure to place the rain gauge in an open area away from interference from overhead obstructions and post it more than one meter above the ground (Figure 7-4). Check the gauge each morning, record the amount of precipitation and the time of measurement, then empty the gauge. If the gauge sits after a rainfall, evaporation can falsify the measurement.

Tides

Programs studying highly stratified estuaries or estuaries with tidal ranges over a few feet may want to measure tidal stage. Tides of sufficient magnitude are effective mixers of estuarine waters and may break down stratification. Even if tidal stage data are not included at the beginning of the sampling effort, the National Oceanic and Atmospheric Administration (NOAA) publishes tide tables for most of the U.S., and this information can be obtained and applied after the fact if the monitoring station is reasonably close to one of the published tide table sites. ■

How to Collect Samples

Units 1-3 in this manual specify sampling and equipment procedures for different chemical, physical, and biological water quality parameters. There are, however, several general tasks that apply whenever water samples are collected. As always, program managers should consult with their laboratory or their sampling equipment instructions for exact requirements.

Before Leaving Home: Preparation of Sampling Containers

Reused sample containers and glassware must be cleaned and rinsed before and after samples are taken. When preparing sampling containers for most chemical and physical water quality parameters, follow these steps:

1. Wear latex or rubber gloves.
2. Wash each sample bottle or piece of glassware with a brush and phosphate-free detergent.
3. Rinse three times with cold tap water.
4. (This step is only for sample containers and glassware used to monitor nitrogen and phosphorus.) Rinse with 10 percent hydrochloric acid.
5. Rinse three times with deionized water.

Equipment used for bacteria sampling must be sterilized in an autoclave, which may require the assistance of a certified lab.

In the Field: Sample Collection

There are several different water collection devices available today. They can be used for most water quality analyses in the field or laboratory.

Surface Samples

Screw-cap bottles and Whirl-pak bags (Figure 7-5) are among the most popular tools for collecting water samples near the surface. The following steps should generally be taken (USEPA, 1997):

- Screw-Cap Bottle
  1. Using a waterproof pen, label the bottle with the site number, date, and time.
  2. Unscrew the bottle cap immediately prior to sampling. Avoid touching the inside of the bottle, its lip, or the cap. If you accidentally touch either, use another one.
  3. <u>Wading:</u>
     Try to disturb as little bottom sediment as possible and take care not to collect water that has sediment from bottom disturbance. Stand facing against the current or tide (if it can be detected). Collect the sample against the current, in front of you (Figure 7-6). You may also tape your bottle to an extension pole to sample from deeper water.

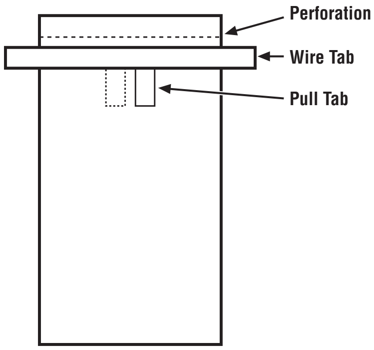

Figure 7-5. Whirl-pak bag. Volunteers can be easily trained to collect water samples with these factory-sealed, disposable bags.

Boat:
Carefully reach over the side; collect the water sample on the upcurrent side of the boat.

4. Hold the bottle near its base and plunge it (opening downward) below the water surface (Figure 7-6). If you are using an extension pole, remove the cap, turn the bottle upside down, and plunge it into the water, against the current or tide. Collect the water sample 8-12 inches below the water surface whenever possible.
5. Turn the bottle into the current and away from you. In slow-moving waters, push the bottle underneath the surface and away from you against the current or tide.
6. Leave a 1-inch air space (except for dissolved oxygen and biochemical oxygen demand samples), so that the bottle can be shaken just before analysis. Recap the bottle carefully, remembering not to touch the inside of the bottle or its lip.
7. Fill in the bottle number and/or site number on the appropriate field data sheet.
8. If the samples are to be analyzed in the lab, place them in the cooler for transport to the lab.

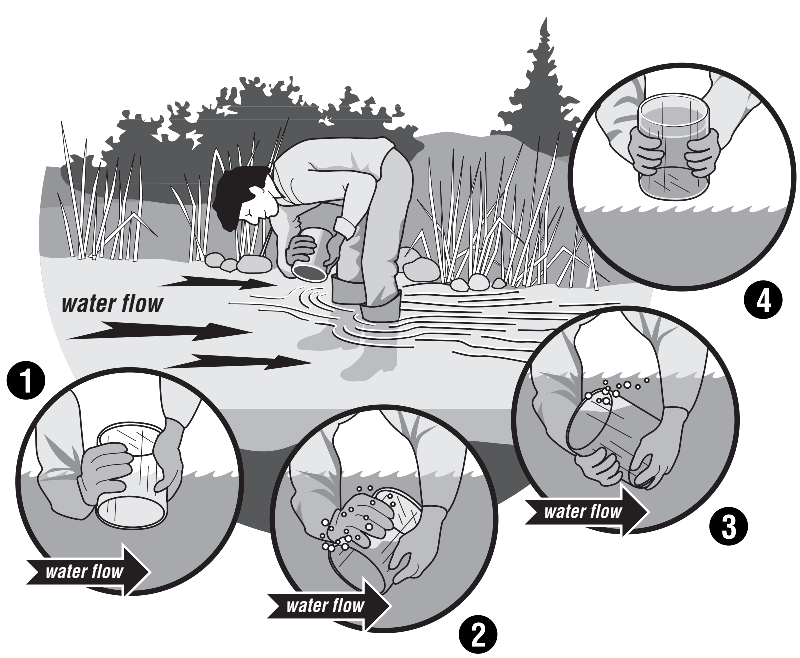

Figure 7-6. Taking a water sample. Turn the container into the current or tide and scoop in an upcurrent direction *(redrawn from USEPA, 1997).*

- Whirl-pak Bag

1. Using a waterproof pen, label the bag with the site number, date, and time.
2. Tear off the top of the bag along the perforation above the wire tab just prior to sampling (Figure 7-5). Avoid touching the inside of the bag. If you accidentally touch the inside of the bag, use another one.
3. Wading:
   Try to disturb as little bottom sediment as possible. In any case, be careful not to collect water that contains sediment. Stand facing against the current or tide. Collect the water sample in front of you.
   Boat:
   Carefully reach over the side; collect the water sample on the upcurrent side of the boat.
4. Hold the two white pull tabs in each hand and lower the bag into the water with the opening facing against the current. Open the bag midway between the surface and the bottom by pulling the white pull tabs. The bag should begin to fill with water. You may need to “scoop” water into the bag by drawing it through the water against the current and away from you. Fill the bag no more than 3/4 full.
5. Lift the bag out of the water, pouring out excess sample. Pull on the wire tabs to close the bag. Continue holding the wire tabs and flip the bag over several times away from you to quickly seal the bag. Fold the ends of the wire tabs together at the top of the bag, being careful not to puncture the bag. Twist them together, forming a loop.

6. Fill in the bag number and/or site number on the appropriate field data sheet.
7. If the samples are to be analyzed in the lab, place them in the cooler for transport to the lab.

Samples at Depth

To accommodate at-depth measurements, equipment supply companies produce several types of water samplers designed to collect water at specific depths through the water column.

Two of the most commonly used samplers in citizen monitoring programs are the Van Dorn and Kemmerer samplers (Figure 7-7). Both samplers have an open cylinder with stoppers at both ends. A calibrated line attaches to the device and allows the volunteer to lower the unit into the water to a precise depth.

After lowering the unit into the water to the proper depth, the volunteer then releases a "messenger"—or weight—down the line. When the messenger hits the sampler, it trips a releasing mechanism and two stoppers seal off the ends of the tube.

If sampling routinely takes place from a bridge, the manager should install a lighter weight messenger on the sampler. Be warned, however, that repeated use of the standard messenger from such heights will eventually damage the unit.

The volunteer should pull the sampler to the surface and transfer the collected water into a sample bottle or—depending on the parameter to be measured—a Whirl-pak bag. Pouring the water from one container to another can aerate the sample, thereby biasing some results (e.g., for dissolved oxygen). To avoid aeration, the volunteer should transfer the water using a rubber hose with an attached push valve. With the end of the hose at the bottom of the empty sample container, the volunteer should fill the bottle to overflowing.

Van Dorn and Kemmerer samplers, their derivations, and samplers designed for particular water quality parameters (e.g., dissolved oxygen) are available from equipment suppliers (Appendix C). Several volunteer groups have also constructed their own samplers. ■

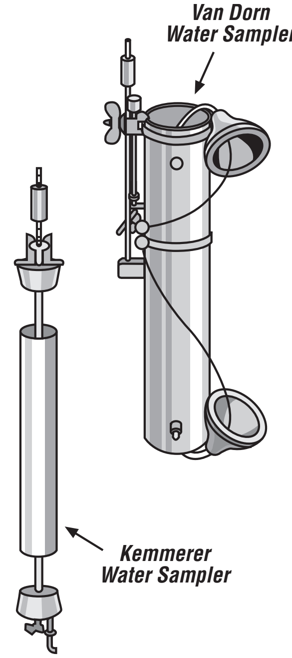

Figure 7-7. Two common water samplers: Kemmerer and Van Dorn *(from APHA et al., 1998).*

The Data Form

In several places in this chapter and throughout the manual, the importance of volunteers completing the data form or data sheet is expressed. The forms, when properly filled out, provide a set of standardized data useful to both managers and scientists. Volunteer program leaders are responsible for continuously emphasizing that properly completed data forms are essential to data quality. Rarely can a data manager feel comfortable asking a volunteer about details from the previous week's sampling exercise; relying on memory is risky.

Data forms should be easy to use and have space for water quality data and all information necessary to analyze, present, and manage the data. Sample data forms are provided in Appendix A. As a backup to the data form, some volunteers may wish to bring a tape recorder into the field to record observations.

While data users and the database manager should be

Volunteers collecting bacteria samples using an extension pole (photo by Weeks Bay Watershed Project).

Volunteers collecting a water sample from a dock using a dissolved oxygen sampler (photo by K. Register).

involved in the development of the data collection form, consideration should also be given to the ease with which volunteers can fill out and understand the form (USEPA, 1990). If the information is not important to the project, it should not be asked for on the data form.

One way to better ensure that volunteers complete the data forms correctly and completely is to involve them in the forms' development. Periodic reviews of the forms should also be conducted. As volunteers gain experience with the forms and monitoring sites, they can provide excellent suggestions for improving the data forms. ■

References and Further Reading

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