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PROCEEDINGS

Fourth National Citizens' Volunteer Monitoring Conference

Putting Volunteer Information to Use

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Portland, Oregon

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WATER

In April, 1994, EPA co-sponsored the fourth in a series of National Volunteer Water Monitoring Conferences. More than 300 people -- volunteer program organizers, volunteer monitors, government and business representatives, and educators -- came to Portland, Oregon to share their experiences, insights, methodologies, questions, and enthusiasm.

The conference included time devoted to small group discussions. What emerged from these discussions was a vision for the future of volunteer monitoring in which:

- Lines of communication are open between data users (especially government agencies) and data gatherers (the volunteer programs).

- EPA plays a strong role at the regional and national levels in enhancing communication, promoting standardization of methods, assisting in data management, and encouraging state use of volunteer data.

- State and local agencies recognize the value of volunteer data.

- Strong state or regional associations of volunteer programs exist to support and promote volunteer monitoring.

- Volunteer monitoring programs adopt a watershed approach.

We have already made great strides toward reaching this vision. As these conference proceedings show, volunteer programs nationwide are working to develop collaborative partnerships with businesses, government, and universities; are exploring ways to increase the quality and utility of their data; and are expanding the scope of their monitoring activities in myriad ways. More and more state and local water quality agencies are recognizing the value of volunteer data, and many are sponsoring their own volunteer monitoring programs. Increasingly, volunteers are seeking involvement in watershed-level decisionmaking.

We hope these conference proceedings will serve as another tool to help us reach the vision articulated in Portland for the future of volunteer monitoring.

Geoffrey H. Grubbs, Director
Assessment and Watershed Protection Division
Office of Wetlands, Oceans, and Watersheds

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Opening Plenary Session

Chuck Clarke
Regional Administrator, U.S. EPA Region 10

Looking Toward the Future of Volunteer Monitoring

I worked for 10 years in the State of Washington's Department of Community Development, which also housed the state's Volunteer Action Council. I have also worked with the Vermont Department of Natural Resources. Based on those experiences, I'd like to talk to you today about what I consider some of the critical components for a volunteer monitoring program, as well as some of the future challenges facing these programs.

Vermont volunteers discover zebra mussels

While I was at the Vermont DNR, the Department set up a monitoring effort to look for zebra mussels in Lake Champlain. Our technical staff spent about two years on the project, and never discovered any zebra mussels, so we assumed they were not there. We also happened to have organized a volunteer monitoring effort for zebra mussels at the same time. We had printed up cards showing what the zebra mussel looked like, and handed it out at events, parks, docks, etc. Last summer, a high school student who was out fishing pulled up a rock with what he suspected was a zebra mussel. He sent it to the agency, and we confirmed that it was in fact an infestation of zebra mussels in that area.

So the agency spent a lot of time and money trying to figure out if there were zebra mussels in that lake, but it was really the volunteer monitors, and the commitment of our staff to work hand in hand with the volunteers, that made the difference.

Critical components of volunteer programs

As I look back over various successful volunteer programs, I see certain components that have been critical:

1. **Leadership.** Most successful programs have one or two core people who are the lifeblood of the effort. It's critically important to train some additional "lifebloods," because if that critical person leaves, the entire effort can die.
2. **Goals and objectives.** Rather than just saying, "The stream's going to be great in two or three years," try to lay out specific interim goals so you can get feedback periodically. If the longterm success is salmon coming back, what are the interim successes that can get you there? You can use these interim successes not only to encourage your volunteers but to help persuade funders to support your efforts. The stronger a story you can tell about your work, the more likely you are to obtain support.
3. **Financial and technical resources.** Make sure you have enough resources not just to collect the data but also to tell your story. If you can't tell your story, your resources will dry up.
4. **Education, education, education.** Get involved in the school system and in public education forums. This is key to bringing about change.

Future trends and needs

If you look at polling data, you see that many people consider jobs more important than the environment. But you have to look at the demographics. If you take college-age kids, high school kids, grade school kids, you'll find that overwhelmingly environmental protection is number one on their list of important public policy issues. There is a disconnect between kids coming up through the system who have been educated on the importance of environmental issues, and us—the more middle-aged—who are still trying to find that balance between jobs and environmental protection. There's a priority change going on, and that means there is going to be more and more pressure on government, volunteer groups, and others to do as much as we can to protect the environment. This offers a real opportunity to volunteer groups.

A second trend is a switch to watershed programs. This will help us pull all our dispersed monitoring efforts together.

A third trend is the decreasing availability of government resources. This will force government to set up more partnerships with the volunteer community.

There is a lot of power sitting in this room. It's like a chemical chain reaction—if we can get to the threshold where enough people are active, fundamental change will start to occur. That's why the volunteer system works.

Virginia Lee
Coastal Resources Center, University of Rhode Island

The Volunteer Monitoring Movement: A Brief History

I was involved in putting together the first national volunteer monitoring conference, in Rhode Island, in 1988. There's been enormous growth since then, and a wonderful, exciting change throughout this country in the ensuing years, and it's a real honor and privilege for me to be here and see this.

Every year since 1988, more and more programs have been formed. There were 95 new programs formed in 1992. The new national directory includes 517 programs.

Early environmental monitoring

Using volunteers to monitor the environment is not a new idea. In 1890, the National Weather Service began training volunteers to report daily measurements of rainfall and air

temperature throughout the country. There are now 11,500 volunteer weather stations nationwide (compared to only 300 nonvolunteer stations). More than 500 of these stations have 100 years of continuous monitoring. Much of our knowledge of our nation's climate is based on these longterm volunteer records.

The National Audubon Society's Christmas Birds Counts started in 1900. In 1929, the U.S. Fish and Wildlife Service started its Bird Banding Program, in which people were trained to capture birds, band birds, and record observations. From that came a lot of our knowledge of migration patterns, of depletion of species, and of changes in habitats.

In 1926, the Izaak Walton League started a "national pollution war." They sent out sample bottles to all their programs and asked people to take water samples and have them analyzed by their local chemist, then send the results back to IWLA headquarters.

In the 1950s, we saw the founding of the National Marine Fisheries Service's cooperative fish tagging program.

Lake and stream monitoring

At the end of the sixties, we come to the beginning of the era of lake and stream monitoring. You have to remember that in the sixties the Cuyahoga River was catching on fire, there were major oil spills and debris problems, we had Ralph Nader giving a funeral service for the Houston ship channel on national TV. People were happy when they had fish kills because at least it meant there were fish to be killed. We had major point source problems, and volunteer monitoring activities reflected that.

Lake programs developed early in the seventies in Maine, Michigan, and Minnesota. In 1969, Malcolm King founded Save Our Streams in Maryland, and in 1970 he persuaded Maryland's Department of Natural Resources to include the SOS program as an item in the state budget. In 1974, the Izaak Walton League of America's national office adopted the SOS concept and promoted it through its state and local chapters. Between 1975 and 1977, the IWLA's "Water Wagon" (a motor home equipped with kick seines, basic field kits, and SOS literature) visited schools and community groups in every state in the contiguous United States, raising community awareness about streams.

The 1972 Clean Water Act, especially the requirement for states to submit reports to EPA and Congress on the "state of the state's waters," provided some of the early impetus for monitoring programs.

The eighties: Growth in credibility and scope

In the eighties, estuary programs caught up with the stream and lake programs. Three estuary monitoring programs—Rhode Island Salt Pond Watchers, the Chesapeake Bay Citizen Monitoring Program, and Maine's Clean Water Program—were all founded in the second half of the eighties. Bacterial monitoring was important to these programs because of the public health issues associated with the shellfish industry.

Another development, which quickly had an impact on national legislation, were the marine debris programs. In 1986, the Center for Marine Conservation developed a data card that was used by volunteers to catalogue debris picked up during the Texas Coastal Cleanup. By 1988 the cleanup had become a national effort, and soon after it became international. Information from the data cards was used to support the MARPOL legislation outlawing disposal of plastics at sea.

Monitoring data from the Acid Rain Monitoring Program were also credible enough to be used in support of national legislation—the new Clean Air Act.

The next phase, and perhaps the most energetic and creative, has been the involvement of schools. Through GREEN (Global Rivers Environmental Education Network), students throughout the U.S., as well as in other countries, are linking up by computer to share monitoring information and experiences in solving water quality problems. That model is now being modified and adopted throughout the country.

A more integrated approach

During the 1990s, we are evolving toward a more integrated approach to monitoring. Now programs are evaluating streams, lakes, estuaries, wetlands, and in some cases groundwater, along with adjacent land uses, in whole-watershed assessments. This approach is linking communities along the watershed in a stronger sense of their connection to the environment and to each other.

An agenda for change

Even though we call it "monitoring," volunteer monitoring has never been about simply monitoring the decline of the system. It has always been about activism—about interpreting the information and making a difference with it. Today we are moving more into urban environments, and making sure we are not only cleaning up these environments, but actually restoring them.

The recommendations that came out of that first workshop, in 1988, have largely been achieved. We took them to Washington the very next month. From those recommendations came the EPA guidance documents, the national newsletter, and the continued support for conferences like this.

I really encourage us to think big this time, to think hard, to engage in discussion, and to come up with an agenda for change with which we can move forward.

(Note: A longer article by Virginia Lee, based on this talk, was published in the Spring 1994 issue of *The Volunteer Monitor* newsletter. To obtain a copy, send a self-addressed envelope with 75¢ postage to The Volunteer Monitor, 1318 Masonic Avenue, San Francisco, CA 94117. Be sure to specify that you want the Spring 1994 issue.)

Involving Volunteers Effectively, Part One

Moderator: **Susan Handley,** U.S. EPA Region 10
Presenter: **Joby Winans,** Washington State Department of Community, Trade and Economic Development

Joby Winans

Washington State Department of Community, Trade and Economic Development

Trends in volunteerism

First I'd like to ask you to tell me something you've seen in the last few years that you would characterize as a *trend* in volunteerism.

Responses from workshop participants:

- It's getting harder to find people who have time.
- Volunteers are getting choosier. They have more choices of where to volunteer.
- It's easier to recruit volunteers for the short term.
- Volunteers come from a wider range of backgrounds.
- We're seeing more older people.
- Volunteers are more interested in environmental issues.
- Volunteers are interested in meeting their own career needs—resume, networking.
- The image is changing. Volunteers used to be people who had nothing else to do with their time.

There is a certain image that we used to associate with volunteers—the little old lady, white, always smiling, not working outside the home, who has 40 hours a week to volunteer. The Latin name for this person is "Volunteerus extinctus no-more-us."

Today volunteers are coming from a wider range of backgrounds and ages. But "Volunteerus extinctus no-more-us" is still the species of volunteer that we tend to expect and look for. For example, the staff of your organization may say, "We need a volunteer in the lab." But who shows up? Not their grandmother—which is who they expect—but an 18-year-old Vietnamese immigrant who doesn't yet speak English very well. The staff says, "This isn't a volunteer."

Nowadays most people don't have the leisure time that they used to. So we're seeing more family volunteering; families are saying, "Let's do something together."

A study done in 1990 on why people volunteer and who volunteers found that the environment as a cause was making headway. About 10 to 12 percent of people wanted to do volunteer work on environmental issues. It's still not as strong as human services or church, which were up around 25 percent each, but people are showing increased interest in the environment.

Volunteers *are* getting choosier. I worked in a food bank here in Portland in 1983, and when I first started, people would knock on my door saying, "I'll work 40 hours a week doing anything you want. Just let me be involved." By 1985, people were saying, "I'll work Tuesdays only, I don't want to deal with any clients, I'll only do computer work, I can work six weeks only because during the winter I go to Arizona and during the summer I go to Alaska. Take it or leave it."

Volunteers are looking for things that meet their needs. We are sellers in a buyer's market right now. If you want volunteers, you have to have a good enough program to get people in the door and keep them in the door. Find out what your volunteers' needs are, and make sure their needs are met.

The old adage is still true: If you want to get something done, find someone who is busy. These are the people who have learned to juggle and get everything done. So if you're recruiting, don't be afraid to go down the street to the Salvation Army and say, "Who's a good volunteer?" You don't have to steal that person away, but you could interest them in doing more than one thing in a week.

One practical thing you can do is make it easy for people to volunteer. Distribute forms around the neighborhood. People can fill out a form and then you contact them. The clearer, more accessible, and more friendly you can be, the more likely you are to get volunteers.

Why people volunteer

Now can you tell me some of the reasons why people volunteer?

Responses from workshop participants:

- to do things that aren't part of their regular job
- to get inside information
- to gain experience and build their resume
- to gain a sense of personal pride and fulfillment
- to satisfy the need to belong
- to achieve something that they value
- to meet people and make friends
- to get recognition
- to learn something

In a recent nationwide study about why people volunteer, the number one answer people gave was that they believed they ought to give something back to their community. The second was that they felt a sense of satisfaction about volunteerism. Number three was that they gained some tangible benefit.

People also said they volunteered "because somebody asked me." Let me say something about asking. One of the main reasons people don't volunteer is that they aren't asked—and having a public service announcement on the radio is not asking. Volunteers want to be asked individually by someone. It doesn't have to be you. You can recruit some volunteers and have them ask their friends and associates.

In Washington, we found that the number one reason why people volunteered was that they had a connection. That relates to volunteer monitoring, because people are afraid of

what's happening to their own back yard, or the park down the street, or the river that runs through their community. They're connected to those things: "I've seen that river my whole life; now it's brown; I want to do something about it"; "I used to fish with my grandfather in that river and now there are no more fish."

Comment from participant: Another reason to volunteer is that "you have to." I have found that court-referral volunteers work three times harder than any other volunteers. Some of them are people who probably would not have volunteered, yet often they end up staying.

Joby Winans: Yes, this is a resource. We could get into a whole philosophical discussion about whether court-ordered volunteers are volunteers are not. I consider mandatory, court-ordered, or therapeutic volunteers to be "potential" volunteers.

For example, take Frankie, a nine-year-ol who was caught shoplifting and ordered to do 12 hours of community service. This was the first time in his life that he had had any kind of a positive experience. He was giving, people were praising him, he was part of the team, he felt wonderful. He did his 12 hours and he left. Two weeks later we got another call: "Frankie's coming back." "Why?" "He shoplifted again."

So Frankie came in and I asked him why he shoplifted again, and he said, "This is the best experience I ever had and I didn't know how to do it again." Remind your staff that when "potential" volunteers get finished with their 50 or 100 hours, to sit down and talk with them about additional volunteer opportunities, and recruit them right there.

Evaluating and thanking volunteers

Oddly enough, volunteers like performance evaluations. Volunteers were asked, "How do you know the people you're volunteering for feel that you've done a good job?" Their response was, "Because they took the time to take my work seriously, they evaluated what I was doing, and they gave me feedback."

The McClelland Model of Motivation

I've found the McClelland Model of Motivation to be a quick, easy way to structure the way I think about people and their differing needs. McClelland says that people have a need either to influence other people, which he called "power," a need to affiliate, or a need to achieve. In each person, one of those motivators is probably stronger than others. So you can try to satisfy those needs in your volunteers.

People are not necessarily motivated by the same things in their volunteer work as in their regular job. The person who is very achievement-oriented on the job may be looking for a more social experience when they volunteer.

What do these categories mean?

1. *Influence or power.* These people are motivated by status. They can work alone or with others. They like to be given a vision of the big picture, and then to have autonomy and independence. They don't like to have other people hanging over them.
2. *Affiliation.* Affiliators like to take care of other people. They work best with others. They like to be popular and they are concerned about relationships.
3. *Achievement.* Achievement-oriented people like to accomplish things. They prefer to work alone. They like projects with a beginning, a middle, and an end, and they like to know the standards by which they're going to be judged. Why? So they can exceed the standards.

I personally am highly achievement-oriented, with some influence/power and no affiliation. So don't bother hugging me on the way out—just tell me that I exceeded your expectations, and keep on going. I tend to stand back and say, "Affiliators waste time! They're talking—or worrying about whether we have donuts. Who cares? I want to get the work done!"

On the surface it may look as if only certain types of people can do certain jobs, but that's not true. Say you are looking for a volunteer to supervise 16 people on a project. Can an influence person do that? Sure. Can an affiliator do that? Very well. They can make sure that everyone feels like part of the team. Can an achievement person lead a team of 16? Sure, especially if you say, "Here are the expectations and here's what you need to do."

Can you get an influence person to stuff envelopes? Yes. How would you do it? Let them write the letter. Say, "Look at all the people you are going to influence." Let them find others to help fold and stuff the letter. Can an affiliator do it? Yes, especially if they are working with a group. An achievement person? Tell them "We've got to get 600 out today," and they can achieve that goal.

What do these categories mean in terms of recruiting, supervising, and thanking volunteers?

Recruitment:

The influence or power person: Tell them, "You can make a difference"; "You'll meet the important people"; "Here's your title"; "This is our vision—we want to you to lead us."

The affiliator: Say, "We need you"; "Come join our family." Invite them to a social event—Meet the Creek.

The achievement person: Say, "We have lots to do—we need your help"; "Here is the project that I need you to do." Set targets.

Supervision:

Influence or power people: Supervise them one on one—but recognize that they will ask questions and argue. Give them autonomy, but don't lie down and let them step on you.

Affiliators: Take the time to talk to them individually. (That's a challenge for the achievement-oriented.)

Achievement people: Tell them, "Here's where we need to go, here are the steps to take. I'll check in with you in a couple of months."

Thanking:

Influence or power people: Give them public recognition. Give them more leadership; promote them.

Affiliators: Do something personal: a party in their honor, a card everyone signed, a gift everyone contributed to.

Achievement people: Tell them *specific* things they've accomplished that you have appreciated. Then give them more responsibility.

It's worth spending some front-end time figuring out what volunteers need and how to keep them satisfied. Continually go through a cycle of evaluation. If you can retain the people you've got, then two things happen. One, you don't have to spend a lot of time running around recruiting more. Two, a satisfied volunteer is the best possible person to recruit more volunteers for you.

Designing Your Water Quality Study

Moderator: **Geoff Dates,** River Watch Network
Presenters: **Geoff Dates; Julie Rector,** Washington Department of Ecology; **Esperanza Stancioff,** University of Maine Cooperative Extension Service

Geoff Dates
River Watch Network

Julie Rector
Washington Department of Ecology

Esperanza Stancioff
University of Maine Cooperative Extension Service

While it may be tempting to get right into the water and begin sampling, the experience of many groups suggests taking the time to figure out what you want to do before you get wet! The process of designing the study forces you to define your purposes and a specific set of questions that you wish to answer. This makes it much more likely that you'll select equipment and procedures appropriate for your purposes, that you'll look for the right indicators in the right places at the right times, and that decision makers will use your data.

A study design deals with the why, what, where, when, who, and how of the sampling and analysis:

A. **WHY** - Issues, questions, uses to be addressed by monitoring
B. **WHAT** - Considerations for selecting water quality indicators to be analyzed
C. **HOW** - Field and laboratory methods and quality assurance/quality control considerations
D. **WHERE** - Sampling and analysis sites considerations and site selection criteria
E. **WHEN** - Sampling schedule considerations for frequency, time of year and time of day
F. **WHO** - Responsibilities for various tasks

Each of these decisions is discussed below.

A. WHY - Issues, questions, uses

Why are you monitoring the water body? What specific questions about it are you trying to answer? Who will use this information? How will they use it? How good do your data need to be to be useful? Design your sampling and analytical activities specifically to address these questions.

1. Identify water uses and values

Your state's Water Quality Standards classify the waters of the state. Each classification has a list of the *designated uses and values* associated with it. For example, common Class A uses for rivers and lakes include public water supply and waters with significant ecological value or waters in their natural condition. Class B uses and values include swimming, fishing, good aesthetics, good aquatic habitat, etc. Your monitoring effort may try to determine whether actual conditions support the uses and values.

2. Identify issues facing the water body

What and where are the activities that threaten the uses and values? Some threats are common to rivers, lakes, and estuaries: sewage discharges, bacterial contamination, and erosion/sedimentation, for example. Some are unique to the water body. Specific river threats include dams and other flow alterations and loss of riffle habitats, and the relatively rapid downstream transport of pollution. Lake threats include nuisance aquatic plant growth and water level fluctuations, and estuary threats include shellfish contamination and dredging for navigation.

3. Determine questions to be answered by monitoring

Some examples:

- Does the water meet state water quality standards?
- Is the water safe to swim in?
- Where are the problem areas?
- What are the sources of problems?
- What is the overall condition of the water?
- What is the impact of pollution sources on aquatic life?
- How does the water body function?
- Is it safe to eat shellfish?

4. Define data quality goals

Data quality goals are narrative statements that link the quality of the data with the intended use of the data. These statements should identify whom you expect to use the data and for what purpose.

For example, suppose you want to evaluate the health risk of water contact at a popular swimming area. Your data quality objective might be to produce data that your local health officer could use to determine whether to post warning signs. Or you might want your state water quality officials to use your data to decide whether action is needed to clean up pollution sources that might be causing contamination.

Data quality requirements refer to certain aspects of your sampling and analysis. For *sampling*, data quality requirements would include how complete (do you have enough samples?), representative (do they represent conditions in the river?), and comparable (can you compare the results from one site to another?) your data need to be to meet your data quality objectives. For the *analysis* of the samples, data quality requirements would include how precise (repeatable), accurate (agreement with a known reference), and sensitive (the detection limit) your methods and equipment need to be.

B. WHAT - Considerations for selecting water quality indicators to be analyzed

Rivers, lakes, and estuaries are very complicated systems of

inter-related physical, chemical, and biological characteristics. It would be impossible to measure them all, so you must select some of these characteristics as *water quality indicators*. In choosing which indicators to monitor, you need to consider (1) What question are you trying to answer? and (2) How difficult, time-consuming, and expensive is the indicator to sample and analyze?

1. What question are you trying to answer?

Here are some examples of questions asked about rivers, lakes, and estuaries, and the indicators commonly selected to answer them.

Examples of questions for rivers:

Does the river meet state water quality standards? Select the water quality indicators that are included in the standards. Indicators commonly included in the standards are *bacteria, dissolved oxygen, temperature, pH, toxic substances,* and *turbidity.* Some states are developing *biocriteria* that use benthic macroinvertebrates as the primary indicator of biological integrity. Some indicators in the standards are not practical for volunteer groups to monitor—toxic substances for example—because the tests are difficult.

What is the impact of a wastewater treatment plant on the river? Sample for indicators contained in the discharge and for characteristics in the river that would be affected by the discharge. Examples include *bacteria, dissolved oxygen, temperature, pH, turbidity* and/or *total suspended solids, oxygen demand, nutrients* (especially *phosphorus*), *benthic macroinvertebrates,* and *algal growth.*

Examples of questions for lakes:

How does the water body function? Simple, cost-effective indicators that require little training and inexpensive equipment are *Secchi disk transparency* and *temperature.* Temperature profile data will help monitors document lake stratification. Additional monitoring may include observations about *land uses, dates of ice-on/ice off, storms, algae problems, location of aquatic plants,* etc.

Are pollution sources a problem? Screen areas for indicators such as *bacteria, total suspended solids,* and *turbidity.* If you decide to work up a water or nutrient budget, you'll need estimates of lake volume as well as flows from the inlets and outlets.

Examples of questions for estuaries:

How does the estuary work? Salinity will tell you about the source and mix of river and ocean water you are sampling. *Nitrogen* is often the nutrient of concern in estuaries (in contrast to freshwater systems, where it is phosphorus).

Is it safe to eat the shellfish? Because *fecal coliform bacteria* is the indicator used by the U.S. Food and Drug Administration, volunteer groups often test for this indicator.

2. How difficult, time-consuming, and expensive is the indicator to sample and analyze?

Table 1 lists the degree of difficulty, time, and expense involved for some common water quality indicators.

C. HOW - Field and laboratory methods; quality assurance/quality control

Once you've selected the water quality indicators you will measure, you then select a *method* for measuring them. The three basic references for methods are:

1. American Public Health Association, et al. 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th edition (generally referred to as "Standard Methods").
2. U.S. EPA. 1983. *Methods for Chemical Analysis of Water and Wastes.* (EPA-440/4-90-010), Cincinnati, OH. 3/83.
3. U.S. EPA. *Methods for Microbiological Analysis of Water and Wastes.*

In these thick books you will find methods to analyze most any water quality indicator you can think of. However, they are written in a technical style that assumes a certain level of experience with laboratory procedures. Many of the commercially available kits use variations on these methods that are more user-friendly for nonprofessionals.

Selecting a method involves three basic considerations:

1. *Your data quality goals.* Consider how sensitive the method must be to enable you to detect levels of each indicator that will be meaningful for your water body and for the users. The most rigorous methods will be required to address data quality goals for determining compliance with water quality standards or assessing pollution impacts for use by state and federal water quality agencies. Meeting community awareness goals requires much less sensitive and rigorous methods.

2. *The difficulty of the method.* Consider how much time and how many people are needed to perform the method, and how much skill is required. Will relatively small errors have a dramatic impact on your results? How soon after collection must the samples be analyzed?

3. *Your available human and financial resources.*

In some cases, you may decide that a particular indicator is not worth analyzing because achieving your data quality requirements is too expensive or complex.

Quality assurance/quality control measures

Quality assurance/quality control measures are those activities you undertake to demonstrate the accuracy (how close to the real result you are) and precision (how reproducible your results are) of your monitoring. Quality assurance can range from measures as simple as clear documentation and training of your field and laboratory procedures to complex sets of "checks" (duplicate samples, split samples, blanks, audits, and so on) designed to reveal problems in your field and laboratory procedures. These are covered in detail in the workshop on "Assuring Quality Data" in Session 2.

If you are using federal funds as part of your monitoring effort, you may need to prepare a "Quality Assurance Project

Plan." This is a document that is similar to your study design, but is organized in a consistent manner for EPA review.

D. WHERE - Sampling and analysis site considerations and site selection criteria

Sampling locations are selected to answer your question(s). For example, if you want to establish baseline information on the water body's overall health, sample a variety of sites that represent the variety of conditions in the watershed. On the other hand, if you want to measure the impact of a pollution discharge on a water body, choose sites that will isolate the impact being assessed. It is often desirable to select sites historically monitored by the state water quality agency.

To select sample sites:

1. Use a topographic map to do a preliminary selection of sites.
2. Field check each site for accessibility, safety, representativeness, and appropriateness. Record directions to the site, a brief description of the site, and other relevant information on a field sheet. Photograph each site at the sample collection point.
3. Place the site description and the photograph in a loose-leaf binder for permanent archiving.

Following are guidelines for selecting sampling locations for specific types of water body:

For rivers: Sites should be located in the main river current and away from the banks. If that is not possible, locate the site next to the bank where homogeneous mixing of the water occurs, such as on an outside bend of the river. Consider variable flow patterns caused by artificial physical structures such as dams, weirs, and wing walls. These may influence the representative quality of the water.

Depending on your purpose, you may want to locate sampling sites at areas of public use for water contact recreation (e.g., swimming areas) or at habitat areas of sensitive species (e.g., holding or spawning areas important to particular fish species).

For macroinvertebrate monitoring, sites should be shallow (1-2 feet deep), "riffle" areas with current between 0.4 and 2.0 feet per second, and rocky/gravelly bottoms.

Generally, three sites should be chosen to "bracket" areas of erosion or point source pollution:

1. a *reference or control site* immediately upstream of any potential impact;
2. an *impact site* immediately downstream of the alteration

Indicator	Difficulty	Time Required	Expense
Bacteria	Moderate	Moderate	Moderate
Dissolved Oxygen	Easy to moderate	Low	Low to Moderate
Oxygen Demand	Moderate	Moderate	Moderate
Temperature	Easy	Low	Low
pH	Easy to moderate	Low	Low to Moderate
Alkalinity	Easy to moderate	Low	Low to Moderate
Turbidity	Easy	Low	Low to Moderate
Total Suspended Solids	Moderate	Moderate	Moderate
Secchi Disk	Easy	Low	Low
Nutrients (nitrogen/phosphorus)	Moderate	Moderate	Moderate
Algal Growth	Easy to Moderate	Low to moderate	Low to Moderate
Weed Growth	Easy to Moderate	Low to moderate	Low
Chlorophyll a	Moderate	Moderate	Moderate
Benthic Macroinvertebrates	Moderate	Low to High	Low to Moderate
Toxic Substances	Difficult	High	High
Salinity	Easy	Low	Low to moderate

Table 1. Difficulty, time required, and expense for some common water quality indicators. (Note: For expense, low = <$100, moderate = $100 - $2,000, high = >$2,000.)

(at the point where the impact is completely integrated with the water);

3. a *recovery site* downstream stream of the impact (where the water has at least partially recovered from the impact).

It is very important that these three sites be as similar as possible in every respect except for the impact being assessed.

For lakes: The first step is to get a bathymetric map of your lake showing depth contours, inlets, and outlets. Once sites are selected, identify three or four landmarks so you can relocate the site.

For monitoring typical conditions, sampling stations should be located in the deepest part of the lake or the deepest part of significant arms or bays. Avoid near-shore areas, areas near inlets, secluded areas, or downwind areas that accumulate windblown algae and debris.

To identify sources of pollution, you need to sample inlets and outlets as well as lake sites.

For estuaries: Site selection in estuaries needs to account for the complex interactions between tides and river flows. A useful site selection tool is a Navigational Chart (from NOAA) which gives depth, latitude and longitude, and navigational aids.

Consider the influence of tides at your sampling location. You may need to sample at several different depths in order to get a representative sample, since fresh water from the river will "float" on the salt water coming in with the tide.

Sample analysis locations

Where you analyze samples—i.e., in the field or in a lab—depends on the water quality indicators you are using and the requirements of the analytical methods you've chosen.

Simple field observations and measurements: Some of the water quality indicators listed above are analyzed by merely observing and estimating them or by simple direct measurements. Examples include width, depth, current velocity, water color, shading, bottom composition, algae cover, temperature, and stream bank characteristics.

More complicated field sampling and analysis: Some indicators are likely to change either immediately or within hours after the sample is collected. In this case, the indicator can either be measured directly from the water (usually with a meter) or a sample can be collected and immediately fixed (stabilized) in the field, then analyzed later in a lab. Field meters may be used for dissolved oxygen, pH, and turbidity, for example. However, meters may be expensive, difficult to operate, and/or less sensitive than laboratory methods. Moreover, the number of sites you can sample will be limited by the number of meters you have.

Laboratory analysis: Laboratory analysis is required to produce precise and accurate results for some indicators. Bacteria, certain forms of phosphorus and nitrogen, suspended solids, biochemical oxygen demand, and benthic macroinvertebrate identification to family level must be done in the lab because they require special equipment or facilities that can't be brought into the field. For others, like pH, alkalinity, and dissolved oxygen, analysis in the lab is easier but not required.

E. WHEN - Sampling schedule considerations for frequency, time of year, and time of day

Next, you will put together your sampling schedule. Consider time of day, holding time, frequency, and time of year.

Time of day: The time of day you collect your samples can greatly affect your results. For example, in waters with dense aquatic vegetation, dissolved oxygen levels fluctuate dramatically over a 24-hour period, with the lowest levels found at sunrise and the highest levels in mid-afternoon. So if you want the worst-case scenario, sample at sunrise. For estuaries, if you want the worst-case scenario, sample consistently at low tide. If you want to establish baseline conditions, sample at all tidal stages.

Holding time: Take into account the maximum holding time the sample can be held for each test. For example, the maximum holding time for *E. coli* bacteria is 6 hours in a container with ice.

Frequency: How often you need to sample depends on what you want to know. For example, if you want to detect sewage pollution events from a possibly failing wastewater treatment plant, analyze bacteria as frequently as possible—daily, perhaps even hourly. Benthic macroinvertebrates need only be sampled once or twice per year in rivers.

Time of year: In deciding the time of year to conduct sampling, consider the uses of the water. If you want to know if the water is safe to swim in, sample in the summer. Also take into account the ease of field work: Do you need to send volunteers out in freezing weather?

For lakes, a major consideration is the seasonal "stratification" (layering) and "turnover" that takes place as water temperatures between the surface and the bottom change and the water layers and mixes accordingly. Year round monitoring will be required to determine when this happens.

F. WHO - Responsibilities for various tasks

Who will collect and analyze the samples? Who will train and manage the volunteers? Make a list of all the tasks that need to be done and identify someone to be in charge of each task. Some of the jobs that need to be done are: volunteer coordinator, field monitor, lab analyst, lab coordinator, sampling team leader, data manager, quality assurance supervisor, etc.

Conclusion

The last step is to have your study design reviewed by someone with experience in designing monitoring studies. Finally, you need to re-evaluate and, if necessary, rework your study design every year, in light of the results of your previous year's work.

The study design process may seem like a lot of work. But the time spent can ultimately save you and your volunteers

many hours of frustration and wasted effort by assuring that your monitoring matches your goals and resources.

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Understanding Biocriteria

Moderator: **Karen Firehock,** Izaak Walton League Save Our Streams
Presenters: **Gretchen Hayslip,** U.S. EPA Region 10; **Donald Duff,** U.S. Forest Service National Partnership Coordinator; **Dave Penrose,** North Carolina Department of Environment, Health, and Natural Resources

Gretchen Hayslip

EPA Region 10

Developing Biocriteria—The EPA Perspective

The ultimate objective of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Historically, water quality programs have focused on methods that evaluate the chemical integrity, and to some extent the physical integrity, of our water bodies (i.e., ambient measurement of conventional pollutants, toxicity testing). To address our remaining water quality problems, we need to develop more comprehensive evaluations that also measure the biological integrity.

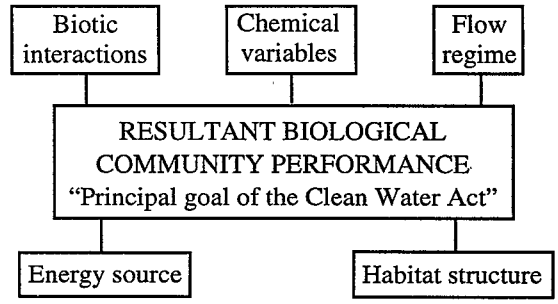
EPA has established a national policy that states should adopt biological criteria (numerical measures or narrative descriptions of biological integrity) in their water quality standards to protect aquatic life uses. At a minimum, states are required to adopt narrative biocriteria during the 1991 – 1993 triennial review period. EPA has developed a number of national guidance documents to assist states in this first step.

Biological integrity - "The ability of an ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats within a region." (from Karr, J.R. and D.R. Dudley, Ecological Perspectives on Water Quality Goals, *Environmental Management* 5:55-68, 1981.)

Biological survey (biosurvey) - Collecting, processing, and analyzing a representative portion of the resident aquatic community to determine the community structure and function.

Biological assessment - An evaluation of the biological condition of a water body using biological surveys and other direct measurements of resident biota in surface waters.

Biological criteria - Numerical values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use.



Factors that influence and determine biological community performance:
Biotic interactions such as predation, disease, and reproduction
Chemical variables such as temperature, dissolved oxygen, metals, and pH
Flow regime such as precipitation, runoff, and volume
Energy source such as sunlight, organic matter inputs, and nutrient availability
Habitat structure such as substrate, riparian vegetation, and channel width and depth.

To date, 35 states are using biological assessments and are in the process of developing biocriteria; four states are using biocriteria in their management or administrative process; and six states—Ohio, Maine, North Carolina, Delaware (marine only), Arkansas, and Georgia—have formally adopted narrative or numeric biocriteria.

The following steps are recommended for developing biocriteria:

1. Select unimpaired (or least-impacted) reference water for each surface water body type in the ecoregion and for each designated use.
2. Characterize the structure and function of resident communities.
3. Establish a protocol for comparing reference sites to impacted sites to determine if impairment has occurred.

Biological criteria require direct measurement (biosurveys) of the aquatic community structure and function to determine the biological integrity. This approach is particularly important to assess the cumulative impacts of multiple discharges, including nonpoint sources, and to detect the impacts of habitat loss and alteration. Biological criteria supplement rather than replace chemical and toxicological methods. States are encouraged to develop water quality standards that include all three assessment methods.

Some of the benefits of biocriteria are that they:

- directly measure the condition of the resource at risk
- detect problems other methods miss or underestimate

- provide a systematic process for measuring progress resulting from water quality programs

Biosurveys can detect the impacts of:

- Pollutants difficult to identify chemically or characterize toxicologically
- Complex or unanticipated exposures (point, nonpoint, storm events, spills)
- Habitat degradation (channelization, sediment, historical contamination)

Some limitations of biocriteria are that they:

- do not directly address non-aquatic life uses (agriculture, industrial, drinking water)
- may not predict impacts from contaminant accumulation in sediment or tissue
- cannot directly identify the cause of an impact

Donald A. Duff

U. S. Department of Agriculture Forest Service/Trout Unlimited

Forest Service Uses of Biocriteria

The USDA Forest Service uses **biocriteria** to monitor the physical, chemical, and biological integrity of streams on the nation's 156 National Forests and grasslands. The Forest Service administers some 128,000 miles of stream and 2.2 million surface acres of lakes and reservoirs on lands within the National Forest System (NFS).

Biological criteria, such as macroinvertebrates and fish, as well as habitat, have been developed to assess the relative health of the aquatic ecosystem, and to demonstrate the effectiveness of best management practices (BMPs) in meeting both federal and state water quality criteria. Some of the more common bioindicators used by the Forest Service include macroinvertebrates (stoneflies, mayflies, caddisflies, etc.), fishes (native cutthroats, sculpin, etc.), and plants (*Carex* species, *Salix* species, etc.). These indicators were selected based on scientific evidence that confirms that measurable changes in these species or groups would indicate trends in the abundance of other species or conditions of biological communities, and the general health of watersheds they were selected to represent.

Over the last 20 years, the Forest Service has been developing and refining an aquatic monitoring program using macroinvertebrates as bioindicators. As biota, macroinvertebrates are more abundant than fish; they may number up to 80 species in a given stream, and may exceed 3,000 organisms per square foot of streambed. Species have been categorized by individual tolerances to particular pollutants, so their presence or absence can provide biological evidence of habitat and water quality.

Aquatic macroinvertebrates have become preferred as key bioindicators for a number of reasons. Population dynamics of macroinvertebrates are easier to follow than those of most microorganisms. Another advantage is that these organisms can repopulate a river section within three months after a perturbation decimates a population. Thus macroinvertebrate populations reflect not only water quality degradation, but also the stream's recovery after the pollution has been eliminated. On the other hand, even the briefest perturbation can eliminate particularly sensitive species, and subsequent sampling can provide early detection of impacts.

The Forest Service has developed a reliable index, called the Biotic Condition Index (BCI), that provides a numerical value expression of the biotic community condition and permits a direct comparison, over time, of the condition and trend of the ecosystem. The BCI has been developed from a database of some 25,000 samples from over 1,000 waters, primarily in the 12 Western states, since 1974. It is based upon general and specific tolerances of species to the variety of environmental stress conditions that may occur. The BCI is an indicator of species richness and biomass, as well as species and taxa dominance, and diversity within the aquatic community.

Macroinvertebrate data offer a complex set of variables. Each of the diversity indices developed over the years has its strengths and weaknesses. None is perfect, not even the BCI, and thus evaluations may require further interpretation based upon other macroinvertebrate data and supporting physical and chemical data. The total number of taxa in the community has been recognized as an important factor for years, but it is possible to have excellent diversity in a tolerant community found in an ecosystem with a history of severe impacts. It is also important to bear in mind that macroinvertebrate data are site-specific and therefore average values for large diverse areas should not be used for decisions.

The BCI is a versatile monitoring tool for evaluating conditions in aquatic ecosystems and associated drainages because it:

1. Measures a stream against its own potential, not that of another stream;
2. Is sensitive to most forms of environmental stress;
3. Is applicable to various types and sizes of streams;
4. Provides a basis for assessment of unstressed conditions;
5. Is independent of sample size, if the sample contains a representative assemblage of the species in the community;
6. Is based upon easily acquired data;
7. Meshes with and supports stream habitat and water quality data;
8. Is easily understood, like a score on a test;
9. Is particularly useful for monitoring trends;
10. Is based mainly upon tolerances to pollution of benthic invertebrate taxa in the sampled community.

The BCI uses several additional parameters to help assess relative conditions of the species and their habitats. These parameters are: (1) stream gradient; (2) stream bottom substrate; (3) riparian vegetation; (4) sulfate (mg/l); (5) total alkalinity (mg/l); and (6) specific conductance.

The scale of BCI values listed below can be used as an indication of the health of a stream ecosystem upon which a defined management strategy can be based for each stream reach.

BCI Value	Stream Condition
above 90	Excellent
80 to 90	Good
72 to 79	Fair
below 72	Poor

The BCI is easily understood because it is like a score on a test. If the score is in the 90s, the condition of the aquatic ecosystem is close to its natural potential. A BCI in the 80s indicates that the aquatic ecosystem is in good condition, but could be better. A BCI score in the 70s indicates some water and habitat degradation. A score of less than 70 indicates severe aquatic ecosystem impacts usually requiring long-term restoration.

Macroinvertebrate data and the BCI have had practical application for land managers and decision makers. For example, the BCI has been used to evaluate and recommend changes in livestock grazing uses.

Each invertebrate species has a specialized niche. When that niche is damaged, a negative population response will soon follow. For example, many invertebrate species depend on the interstitial spaces between rocks to shelter them from the current velocities common to mountain stream riffles. If these spaces are filled by sediment, the number of associated benthic species will decrease. However, there may be a corresponding increase in species that burrow into sediment.

Thus, a land manager who notes a shift in community composition from intolerant species (clean water) toward those species tolerant of sediment can conclude that sediment is accumulating in the stream substrates in significant quantities over natural conditions. This change in composition is important to fish populations since it causes a shift in available food sources. It may also indicate changing conditions of fish spawning and over-wintering habitat because both are adversely affected by increased sediment accumulation.

Invertebrates can be used to monitor changes along a stream as well as in it. One group of taxa are called shredders because they use deciduous leaves in a stream as food. An abundance of these taxa can indicate ample streamside vegetation, while a scarcity of these taxa may point to a perturbation that has reduced or eliminated streamside plants.

Positive or negative effects from almost every activity that occurs in a drainage are eventually reflected in the macroinvertebrate community composition of the streams that drain it. This community composition can reveal the health of the ecosystem, provide a warning system, or reflect the relative intensity of pollution problems. Macroinvertebrate analysis often can identify the type(s) of pollution, making it a valuable tool for conscientious land managers.

Since the Forest Service began its biological monitoring programs in the 1970s, all nine Regions of the Forest Service, involving more than 50 percent of all the National Forests, have used macroinvertebrates as their bioindicators. They have utilized the biocriteria developed by the Forest Service Aquatic Ecosystem Analysis Laboratory in Provo, Utah. These biocriteria and sampling protocols are contained within a Forest Service handbook, which provides survey techniques and sampling methodology. (A copy may be obtained by writing to Donald Duff at USDA Forest Service, 125 S. State St., Salt Lake City, UT 84138.)

The Forest Service will continue to utilize biological criteria to assess conditions on National Forest System lands. Many volunteer water quality monitoring opportunities are available from local National Forest Offices in your area. This affords a good opportunity for you, the public, to become involved and participate in the management of land and water resources on your National Forests.

David Penrose

North Carolina Department of Environment, Health, and Natural Resources

Biocriteria in North Carolina

The design and use of biological criteria, or biocriteria, has become a priority issue among most state biological monitoring groups and many federal programs. A 1991 EPA document noted that 31 state biological monitoring groups are actively involved in the research, development, or implementation of biological criteria. In addition, nearly one-half of the states have adopted the use of rapid bioassessment protocols for the assessment of biological criteria.

Two types of biocriteria are being generated: narrative and numeric criteria. Many states, including North Carolina, have opted to establish narrative biological criteria in their water quality regulations. Narrative biocriteria are general statements of attainable or attained conditions of biological integrity and water quality for a given water quality use designation. Numeric biocriteria are based on the same concept as narrative biocriteria, but include discrete quantitative values.

Development of biocriteria in North Carolina

North Carolina has approximately 37,000 miles of freshwater streams and rivers with 2,700 known point sources of pollution and myriad sources of nonpoint source runoff. Before 1974, North Carolina monitored water quality by

collecting data for conventional pollutants in streams receiving poorly treated wastes bearing large amounts of biochemical, oxygen-demanding substances. At that time, the North Carolina Division of Environmental Management consisted entirely of engineers, chemists, and technicians.

In 1974, North Carolina's Division of Environmental Management hired its first biologist and began to use EPA-approved methods to gather data on plankton, periphyton, and benthos. As collection of in-stream biological data was new to the state, division managers had to be convinced of its value as a tool in water quality management.

Most of the surveys prior to 1980 were conducted using either EPA-approved collection techniques such as Hester-Dendy multiplate samplers or kick net samples from riffles. Eventually, the biologists within the Division of Environmental Management recognized a need to develop a new macroinvertebrate sampling methodology. The artificial substrates then being used did not sample the entire benthic community, required repeated trips to the site, and were often found missing on return trips because of vandalism or high flows. Therefore, semiqualitative techniques were developed (Lenat 1988) that improved ways data were used for biological assessment and proved to be more cost effective. As a result, more useful criteria and bioclassifications were developed. The bioclassifications were developed using data generated from reference streams in each of the three major ecoregion types in North Carolina: Mountains, Piedmont, and Coastal Plain. Biocriteria for additional ecoregion types are currently being analyzed.

Our collection protocols define two collection techniques: full scale and EPT. For full scale collections, 10 samples are collected at each location and all benthic insects are collected and identified. For EPT collections, only four samples are collected and only Ephemeroptera, Plecoptera, and Trichoptera are collected and identified. The full scale method takes about two hours per site, while the EPT method takes about one-half hour.

The taxa richness criteria for wadable freshwater streams in North Carolina are listed in Table 1. These data include criteria for full scale and EPT investigations.

In addition to taxa richness, biotic index values, which are based on the pollution tolerances of each individual species, also are calculated for each sample. Equal weight is given to each metric, the biotic index and EPT taxa richness, in assigning bioclassifications. The use of both metrics has proven to be beneficial, particularly in instances where the taxa richness values alone are borderline between classifications.

Biological information is incorporated extensively into North Carolina's water quality program. The uses of biological information range from identifying appropriate classifications for waters within entire watersheds to determining compliance of specific discharges with narrative standards for protecting aquatic life.

Specific biological indices, or numeric biocriteria, and metrics are not included in North Carolina's water quality regulations. However, biological data and biocriteria are intrinsically linked to the use classifications and to standards that protect these uses. These data and criteria are used extensively to identify waters of special concern and those with exceptional water quality.

Sources of variability

The implementation of biological criteria into water quality regulations will be an efficient regulatory tool if data variability can be adequately addressed. Some sources of data variability are discussed below.

1. Seasonality. Taxa richness of benthic macroinvertebrates has been shown to vary with season (Hynes 1972). Spring and winter peaks in abundance and total taxa richness values of mayflies and stoneflies have been noted in several studies in mountain and upper piedmont streams. For example, 5-6 *Isoperla* species are often collected from mountain streams in North Carolina only during winter months. Furthermore, seasonal peaks in productivity likely shift from one ecoregion to another as the seasons advance. Seasonal variation is greatest in undisturbed streams, while these changes are less likely in highly polluted stream systems.

How can biological criteria be adjusted to account for seasonality? Making proportional adjustments for all locations by season does not appear to be an accurate method.

Table 1. Biological Criteria (EPT Taxa Richness)[a] for Different Ecoregions of North Carolina Used to Determine Water Quality (WQ) Levels for Specific Use Classifications[b]

	Full Scale			EPT		
WQ Rating	Mountains	Piedmont	Coastal	Mountains	Piedmont	Coastal
Excellent	>41	>31	>27	>35	>27	>23
Good	32-41	24-31	21-27	28-35	21-27	18-23
Good/Fair	22-31	16-23	14-20	19-27	14-20	12-17
Fair	12-21	8-15	7-13	11-18	7-13	6-11
Poor	0-11	0-7	0-6	0-10	0-6	0-5

[a] EPT Taxa Richness for Ephemeroptera+Plecoptera+Trichoptera

Rather, one possible way to correct for the effects of seasonality is to subtract out the seasonally dominant taxa before the data are used to assess impacts. However, the critical step in this type of analysis is knowledge of the ecology, and particularly life cycles, of benthic taxa from ecoregion-specific reference locations. Biologists in North Carolina are in the process of producing a list of "spring species" that should be useful for much of the Southeast. The importance of control sites, especially ecoregion reference sites, cannot be overemphasized in making water quality assessments.

2. Stream size (order) or river continuum. Taxa richness values tend to increase with stream order from first through fifth orders (Minshall et al. 1985). This trend is closely related to habitat diversity; whereas small first-order streams are often habitat-limited because of size or flow, larger streams (greater than fifth-order) are often habitat-limited due to the effects of sedimentation. Midorder streams are the most diverse.

North Carolina investigations have indicated that taxa richness values need to be corrected for stream size. Currently North Carolina is using a correction factor of 1.45 for streams 1 - 2 meters in width (< 1 square mile catchment size) and 1.25 for streams 3 - 4 meters in width (1 - 3.5 square mile catchment size). North Carolina's adjustments to criteria are applied to multiple-habitat sampling. These patterns may not be the same for single-habitat or 100-count samples.

3. Defining the reference condition. Most state biomonitoring groups typically establish several types of reference locations during monitoring programs. These can include upstream-downstream, near field–far field and ecoregion-specific reference locations. The ecoregion concept suggests that streams within a relatively uniform geographic area will have similar faunas, or at least similar community structure (Hughes and Larsen 1988).

Examples of the process of reference site selection are discussed in the EPA Program Guide (EPA 1990) and in the Stream Regionalization Project (SRP) in Ohio (Larsen et al 1986 and Whittier et al. 1987). Several questions concerning reference site location are still under investigation. These include: How large must the reference catchments be, and should they be standardized? How many reference locations should there be per ecoregion, and how often should the data be collected to ensure statistical significance? How well will the ecoregion concept apply to other surface water types (wetlands, for example)?

4. Use of multi-metric indices. Several applied indices are currently available for measuring the biological integrity of aquatic systems. These include several multi-metric indices such as the Index of Biotic Integrity or IBI (Karr 1981), the Invertebrate Community Index or ICI, and the Index of Well Being or Iwb (Ohio EPA 1988), which incorporate several taxonomic and functional aspects of community health into a metric. Other common indices used in Region 4 states include taxa richness, EPT taxa richness, species pollution tolerance values, and species diversity indices.

There has been considerable discussion dealing with the choice of metrics for use in biomonitoring programs. The metrics chosen have historically been tied into the collection process and how the information will be used in regulation. Should all states be encouraged to standardize analysis metrics to permit ecoregional comparisons? Biologists in EPA Region 4 have encouraged the development of interstate (i.e., Mississippi-Alabama), as well as interregional (i.e., North Carolina-Virginia, Kentucky-Ohio) biological investigations.

5. Habitat analyses. *The assessment of habitat quality is an essential element in biological investigations.* Habitat assessment techniques have been described in the Rapid Bioassessment Protocol document (Plafkin et al. 1989). All states and volunteer groups should be encouraged to develop accurate habitat assessment techniques. However, it should also be realized that habitat assessment techniques will need to be tested to assure validity, and regionalized for different states and ecoregions.

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Defining Data Use: Are We All Speaking the Same Language?

Moderator: **Abby Markowitz,** Maryland Save Our Streams
Presenters: **Liz Hoenig,** City of Olympia Stream Team; **Patricia Hurley,** Alabama Department of Environmental Management; **Abby Markowitz**

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City of Olympia Public Works Department

As people involved in volunteer monitoring, we are all familiar with the term "data use." In our experience as program coordinators we have increasingly recognized that there is often a language gap among various program participants when it comes to defining and understanding data use. Further, agencies and organizations at the local, state, and federal levels often define terms differently among themselves. Add in the media, and other constituencies that may have an interest in data, and we have an even larger divergence of understanding.

An experience in Alabama illustrates this dilemma: In participant evaluations of Alabama Water Watch training sessions, presenters' terminology consistently received low marks from volunteers. Patty Hurley, with the DEM, explained that the language used by presenters was "filled with acronyms, and referred to organizations and programs too numerous to mention; words were inaccurately interpreted and scientific standards misunderstood." This evaluation has enabled DEM and Water Watch to implement strategies designed to improve communication among partners.

In order to use data effectively, we all need to speak the same language. And each of *us*, to be effective, must be able to understand and articulate those different ideas. What we need is a common language and way of articulating how and why differing entities use data.

Demystifying the world of watershed and water resource management professionals is a critical step in forging a shared understanding since it enables communities to understand how agencies work and what their responsibilities are. Although volunteers become monitors for various reasons, they almost always have one thing in common: the desire to protect and/or improve a water body. This means, then, that monitors want the data they collect to have a positive impact on water quality.

But because there is a lack of understanding concerning both what agencies actually do *and* how they do it, there is often frustration on the part of volunteers and fear of citizen anger on the part of agencies. For most volunteers, using data implies tangible action by someone or some group in a decision-making position, such as the passage of an ordinance; enforcement of an existing regulation; or implementation of measures that will correct a problem or ensure against future problems. Most of us, before we get into this field, don't really understand the processes that must happen before any of these actions can be taken. Clarifying ***process*** is a critical factor in defining data use.

For example, someone who works for a state agency may say data are being used "to develop a baseline." While this is certainly a valid use, it has very little meaning to most volunteers. Therefore, it is not enough to reply to a volunteer's question, "How are the data I collect being used?" with "to develop a baseline." The answer must also include an explanation of why baseline data are essential in documenting conditions and how this documentation relates to water quality protection.

Similarly, saying data are used in 305(b) reports is meaningless unless one actually knows what the significance of a 305(b) report is. Do most people know that the 305(b) is how EPA and Congress learn what the "state of the states' waters" is? Do they also know that often resources are allocated and programs are implemented based on the results of water quality assessments like the 305(b) and a variety of other assessment reports done at the local, state, and federal levels? These are important concepts for citizen volunteers to understand. Reports, assessments, and databases are the tools of watershed management and water quality protection. Building a volunteer monitoring movement requires that we equip volunteers with a knowledge of how these tools work. Otherwise it is like asking volunteers to measure temperature without showing them how to read the thermometer.

Engaging in ongoing dialogue about data use can lead the way to developing new monitoring programs and *new uses* for data. For example, Maryland Save Our Streams' Project Heartbeat, a volunteer biological monitoring program, was piloted as a program in Baltimore County as a way to collect data on existing conditions for local land use planning. Now, due to the County's need to monitor the success of capital waterway improvement programs, discussions are underway to adapt Heartbeat to assess the impact of best management practices in stream restoration programs.

Building a common language also requires us to expand our vision. According to the latest edition of the *National Directory of Volunteer Environmental Monitoring Programs,* "education" is the number one data use listed by volunteer programs. However, many participants during this workshop

felt that monitoring for educational purposes implied a "fluffy" program that didn't really provide "high-quality data." We educate people in the hopes that this will eventually lead to behavioral changes. Changing behaviors is more than a commitment to environmentally friendly products, lawn care, household disposal, etc. Education and behavioral changes also include the capacity for all stakeholders to share the responsibility for setting an agenda, developing strategies, creating a constituency for those strategies, and implementing appropriate action. While this can be a long and frustrating process, it is certainly not "fluffy." The creation of an educated and articulate watershed constituency that includes all stakeholders would most definitely be a positive behavioral change—and a significant use of data—in most watersheds.

The Olympia Stream Team program lists among its data users "volunteers, City and County environmental staff, managers and elected officials, community organizations, state and federal agencies." One data use that each of these partners shares is the ability of the program to bring them together as stakeholders. Each entity uses the data to educate themselves and each other. Data collection and use as a relationship builder is an educational use that may often be overlooked.

Another area of our language surrounding data use that needs some work are the concepts and terms associated with "red flags" and "watchdogging." These terms are popular with volunteers because they imply a stewardship ethic; taking care of that stream, creek, or lake. However, these same terms often strike fear into the hearts of regulators and management professionals who know the reality of not being able to immediately deal with every problem.

As discussed earlier, this problem can be partially alleviated by an understanding of governmental process. It can be further alleviated by a willingness on the part of agencies and volunteers to work in partnership to develop methods and strategies for community reporting that don't start out in a combative posture and to create systems for more timely mitigation of problems. We might also alter the terms we use. For instance, we might substitute *problem identification* for *watchdogging* as the latter term can lead to the idea that there is a deliberate effort to cover up or ignore problems.

The following terms were listed as uses of volunteer-collected data in the *National Directory:*

- education
- problem identification
- local decisions
- research
- nonpoint source assessment
- watershed planning
- habitat restoration
- water classification/standards
- enforcement
- legislation
- 305(b) reporting

Each of these terms could benefit from further definition. We recommend that each of us take this list and, in the context of our own programs, learn to articulate them from the perspectives of various partners and stakeholders such as local, state, and federal government; volunteers and communities; the media; businesses; and academia. This ongoing exercise will help in beginning to develop that common language. The more specific, accurate, and positive we can be in describing the uses of data, the better able everyone will be to develop partnerships and implement environmental improvement—which is why we are all here in the first place.

Collaborative Partnerships: It's Good Business

Moderator: **Linda Macpherson,** CH2M Hill
Presenters: **Sharon Behar,** River Watch Network; **John Jackson,** Unified Sewerage Agency; **Meg Kerr,** University of Rhode Island Coastal Resources Center; **Jack McGowan,** Stop Oregon Litter and Vandalism (SOLV); **Darrell Simms,** City of Portland Environmental Services

Sharon Behar
River Watch Network

Creating Partnerships with Businesses

Why establish partnerships?

There's a big difference between simply accepting a donation from a business, and forming a partnership. There are two reasons why it's important for local monitoring groups to consider creating partnerships. First, in the design phase of a project, we encourage River Watch groups to incorporate all facets of the community. This builds trust, which is especially important if a controversial issue arises later on. The second reason is to diversify your funding base.

Volunteer monitoring groups are in a strong position to form partnerships with businesses right now. River monitoring and water quality are hot issues today. Also, local businesses are reaffirming the importance of their role in the community, and most of our groups are local.

Benefits

The benefits businesses get are the marketing, the public relations, the bridges between the business and the community—and also, quite frankly, businesses want to be among the first to know if a water quality problem is found. If they've been involved in the monitoring project from the beginning, they don't have to read about it in the newspaper.

For volunteer monitoring groups, the benefits are increased visibility, increased diversity in our members, access to services that we might not otherwise be able to obtain, funding that is usually obtained more easily and quickly than foundation funding, and an increase in our volunteer base.

Drawbacks

There are also drawbacks. For the business, the decision-making process of a nonprofit volunteer organization can be very frustrating.

For volunteer monitoring groups, the business partnership can decrease our viability in some realms. We have to be careful about the image we project to the community. We don't want to be seen as "selling out." It's important to be extremely careful in choosing the language used to describe the partnership. There may be resistance on the part of our staff to "sleeping with the enemy." If there is debate in the volunteer organization over whether to form a partnership with a particular business, consider two questions: (1) Does this partnership give us access to people who will change how the company operates? and (2) If we decide not to form the partnership, or not to take the money, how does this further our mission?

Kinds of business donations

There are two basic kinds of donations: funding and noncash gifts. Funding can be through corporate foundation grants, corporate giving, matching gift programs, or awards. Corporate foundation grants tend to be for larger amounts of money, but the funding is difficult to get. Corporate giving and matching gifts are easier routes for most volunteer groups. Many corporations have a variety of award services for community groups.

Having a business sponsor an event is another very popular route. But I caution people not to do events to raise money. The real reason for an event is to build awareness and gain publicity.

Noncash gifts can include public relations, products, services and facilities, employee volunteerism, and program-related investments.

Elements of a healthy partnership

These are some of the elements that we have found essential for building healthy partnerships:

1. A contact person—someone in the business who can tell you the ins and outs, and look out for you.
2. Assessment of the corporate culture. Does their mission fit your mission? Do they have a centralized or decentralized decision-making process? (You'll have an easier time if their process is centralized.)
3. Support of top management. The CEO needs to be the one who goes out and collects the first water sample.
4. Clear wording describing the partnership.
5. Clear expectations. What does the business want? What do you want?
6. Clear roles. Who will do the PR? Who will write the press releases? Whose job is it to get the business's employees out to volunteer?
7. Evaluation. Evaluate regularly to clarify your roles and expectations.

Steps in creating a partnership

1. Decide if it is right for your group. Talk to your board and your volunteers before you approach the corporation or business.
2. Find contact people in the business. Don't make cold

calls. Brainstorm with your board and your volunteers; find out who knows whom. Put together a list.

3. Design clear materials that will show the business who you are, what you're doing, and what you want from them. Don't be afraid to ask for what you want. You can offer an array: "Here are four things that we need; what would work for you?"
4. Do your homework. Read their annual report; find out what kind of giving they've done before. Match your needs with what you know about the company.
5. Now comes the actual meeting. Don't go alone; bring a staff member, board member, or volunteer. It helps to bring someone whose style is different from yours.
6. At the meeting, focus on general agreements before you get to the specifics.
7. Take the time to work out the details, and put them in writing. This process can take several months.
8. Evaluate.

Meg Kerr

Coastal Resources Center, University of Rhode Island

Using Business Partnerships to Enhance Volunteer Monitoring

Current status of corporate funding for monitoring

Currently, volunteer monitoring groups in the United States do not receive significant amounts of funding from businesses. Data compiled for the *National Directory of Volunteer Environmental Monitoring Programs,* Fourth Edition, show that only 81 of the 517 programs listed in the directory (15.7%) receive some portion of their budget from corporate sources. Of these programs, only 22 (4%) receive more than half of their funding from corporations.

These numbers are disappointing. Volunteer monitoring programs need to make an effort to develop linkages with businesses in their community. Monitors need to creatively evaluate a business's environmental interests, compare these interests to their own monitoring goals, and create partnerships with the business that will benefit both the environment and the bottom line.

Why should businesses support environmental causes?

A growing body of research demonstrates a correlation between socially responsible business practices and good financial performance. Covenant Investment Management in Chicago has compiled a database that compares corporate social and environmental performance with financial performance. The largest companies in the country were evaluated for their social and environmental records, ranked, and then evaluated for their financial performance. Covenant's top 200 business stocks increased 100% in value over the last five years while the bottom 200 were up 76.6%. This compares to the Standard and Poors 500 which was up 85.4%. According to Anthony Carfang, President of Covenant, "Essentially the most important criteria suggest that companies must focus on long-term factors which increase shareholder value and avoid business practices which erode shareholder value. Factors which enhance shareholder value include the organization and productivity of labor, customer loyalty, employee benefits, training, supplier relations, and access to capital. Factors identified by the research as eroding shareholder value include poor labor relations, unsafe workplaces, environmental noncompliance, regulatory difficulties, unsafe products, and unfair competitive practices."

Roger Starch Worldwide conducted a survey for Cone Communications, a marketing and public relations firm in Boston, to examine whether Americans favor socially responsible companies and products. According to the survey, when given a choice between two products equal in price and quality, 78 percent of the 1,981 adults surveyed were more likely to buy a product associated with a cause they cared about, 66 percent said they would switch brands to support a cause they care about, and 54 percent would pay more for a product that supported a cause they cared about.

Linkages between businesses and water monitoring projects

Volunteer monitoring programs designed to assess water quality and work toward solutions to pollution problems have a lot to offer a business partner. Many businesses are dependent on water and have a vested interest in keeping the water clean. Manufacturing facilities, for example, often need clean water for their industrial processes and for cooling machinery. Many times, this process water is directly removed from a nearby river or lake. A volunteer monitoring program should be able to demonstrate to the industry that removing pollution above their water withdrawal will save money. Some of these savings can be invested in the group's long-range monitoring projects.

Many industries also dispose of their treated wastes in nearby surface waters. These industries are interested in maintaining the quality of the water above and below their plant, since they are liable for water quality violations that may result from their discharge. These industries are often required to monitor their effluent and the receiving water body. Partnerships built with these industries can sometimes include an exchange of in-kind laboratory services.

Regulated industries rely on a careful work force to operate pollution control equipment and prevent spills and accidents on site. Many times, the more the employees know about the reasons behind control requirements and the impact of uncontrolled emissions on the local environment, the more careful they are on the job. Environmental monitoring groups can easily provide this education in exchange for monetary support for their monitoring program.

A number of tourism industries are dependent on a clean environment. The recreational fishing industry is a signifi-

cant part of the local economy in many areas. Bait and tackle stores, canoe and boat rentals, fishing guides, motels, and restaurants can be supported by recreational fishermen. Since these industries are clearly vested in clean water, they are often open to partnerships with monitoring programs. These partnerships often include donations of boats and equipment for monitoring events and joint sponsorships of cleanups and festivals.

Creating a business partnership

There are any number of reasons why businesses could be interested in a monitoring partnership. Each partnership is unique, but there are some general principles that can help when developing a marketing strategy for your monitoring program.

1. Identify what the business needs that your program is uniquely able to provide. Do they need clean water? Do they need publicity? Are they interested in breaking into a new marketing niche that your group has access to?
2. Identify what the business can provide to your organization. We all would like financial support, but many times businesses have other capabilities that can greatly enhance our programs at little or no cost to the business. For example, many businesses have public relations staff and good media connections, and they can help with publicity. Businesses often have in-house publications departments that can assist with layout and production of brochures and reports. Some businesses can easily host events, such as lunches and conferences.
3. Identify ways to involve employees in your event or organization. This can be a selling point for your partnership.
4. Identify the audience reached by your organization. Are these individuals potential customers for your business partner?
5. Identify an individual in the business who is sympathetic to your cause. If possible, look for someone in upper management who can influence business decisions. Are any of the managers active in local environmental organizations like the Sierra Club or Audubon? Who are the hikers, boaters, fishers?
6. Develop a carefully crafted presentation on your partnership that highlights the benefits to the business.
7. Once the partnership is established, be sure you are giving the business what you promised. If they need publicity, be sure you mention them in all your press releases, in your reports, and in your discussions with the media. If they are interested in clean water, keep them up-to-date on your monitoring successes and failures.
8. Maintain an open dialog with the business. Continue to re-evaluate the needs of both partners as the partnership develops and grows.

River Rescue: A successful partnership

River Rescue is a volunteer monitoring program focusing on Rhode Island's urban rivers. It was established in 1990 as a partnership between Citizens Bank, the University of Rhode Island (URI), and Rhode Island Sea Grant. Citizens Bank provides primary financial support for the program with supplemental funding from RI Sea Grant. URI provides the technical expertise for the monitoring program.

Citizens Bank initiated River Rescue in an effort to distinguish themselves from their competitors. All banks offer the same services, but few take an active interest in environmental protection and stewardship. Citizens Bank was also interested in promoting environmental stewardship to their employees, and the monitoring program provided an opportunity for Citizens Bank staff to work cooperatively on environmental issues with the local community. The monitoring program was also a logical extension of the corporate mission of Citizens Bank's parent company, the Royal Bank of Scotland. The Royal Bank of Scotland recognizes that environmental protection is an important concern of their customers, and actively encourages environmental protection efforts in their subsidiaries.

The special assets of Citizens Bank and URI are effectively used within the River Rescue partnership. Citizens Bank public relations staff promote and support River Rescue events, Citizens Bank produces River Rescue reports, and Citizens Bank employees volunteer for the program. URI provides all the scientific support for the program. In addition, the program is coordinated by URI staff who recruit and train volunteers, and work with other environmental programs to promote stewardship for the rivers.

Darrell Simms

City of Portland Environmental Services

Involving Minority Populations in Business Partnerships

I'd like to give you some ideas on how you might include people of color as you go out and build partnerships with businesses. In fact, that's my job—I'm a Workforce Consultant in Diversity for the City of Portland. I help the City of Portland involve women, minorities, and youth in business opportunities.

As you begin to build business partnerships, ask yourself, How can I involve minority populations? How can I involve those populations that might seem not to be interested? Minorities *are* interested, but they don't necessarily respond to the "traditional approach." People like to do business with people who look like them. Coca-Cola, the only Fortune 500 corporation with a minority CEO, has increased its profits 225 percent by being able to focus on minority populations.

Involving minorities in the environmental movement takes creativity. It takes having consultants come in to work with

you. It takes training. It takes a "major paradigm shift." For example, I'm going to be addressing a Korean group soon, and they are going to provide a translator. That's creative.

One of the greatest ways to get minorities involved is through church ministers. Or go to the Urban League; they know how to get people out to meetings. In the Asian community, it's very important to seek out the business leadership.

Be aware of some of the problems in the business world. Businesses are being downsized. Show some understanding and sympathy for their problems.

There's a major competition for partnerships with businesses. Businesses only have so many resources. Some of your best champions are the minorities because they haven't been asked before. That's fresh talent.

Observational Monitoring

Moderator: **Jeff Schloss,** University of New Hampshire Cooperative Extension
Presenters: **Tom Murdoch,*** Adopt-A-Stream Foundation; **Ivy Frances,** City of Portland Environmental Services; **Ken Pritchard,*** Adopt-A-Beach

Ivy Frances
City of Portland Environmental Services

Observational Monitoring Using Streamwalk

There are many citizen monitoring programs, manuals, and techniques out there. Make sure the one you choose gathers the data you want, and is a program that can be successful for you.

Streamwalk is a citizen observational monitoring program developed by U.S. EPA, Region 10. The program is based on a short check-off list of observations made about the stream and surrounding areas. Streamwalk is geared for citizens from the sixth grade to adult.

At the City of Portland Environmental Services, we built a program around Streamwalk to establish two things: consistency in data collection and support for citizen monitors. Because we had an established program, when citizens wanted to volunteer, we had the a program ready to put their efforts into. We did not have to develop a customized program for each request, which can be time-consuming and costly. Through communication and feedback built into the program we provided support to each Streamwalker.

Each new Streamwalker is trained by an experienced Streamwalker. Training is important, to maintain consistency. Each Streamwalker chooses the site or sites which he or she will monitor. Training at the Streamwalker's monitoring site is optimal. Each Streamwalker receives a Streamwalk Kit—a plastic filing box that contains:

- introductory letter
- topographic map on which the monitoring site is marked
- Streamwalk manual
- data collection sheets (enough for one year)
- monitoring schedule
- background information about the stream and watershed
- a list of phone numbers for reporting emergency spills, fish kills, and hazardous materials

Each Streamwalker is asked to make a one-year commitment. If a volunteer no longer wants to monitor, the box and its contents are returned and can be used by another volunteer. The schedule establishes the months for monitoring: January, April, July, and October. A Streamwalker can monitor any day during this month, but the information must be turned in by the 15th of the next month. This schedule gives the Streamwalker flexibility while also giving us some consistency among all the Streamwalkers collecting data. Establishing the due date also gives a bit more incentive for Streamwalkers to send the data in.

On the original Streamwalk data sheets designed by Region 10 EPA, the Streamwalker is asked to send the information to the EPA Region 10 office. However, we changed the address to the City of Portland Environmental Services. This is important for several reasons. First, we review the information and keep a record of it ourselves. Not only are we gathering information about trends, but we can have an immediate response to any problems described on the data sheet. It puts us in direct communication with each Streamwalker in our area.

Some final tips on observational monitoring:

1. Use observational monitoring as a teaching tool.
2. Always use the same site.
3. Go out with a trainer.
4. Always have the reference manual with you (important for consistency of data).
5. Be aware of things that are difficult for citizen monitors and give as much support as possible. For example, latitude and longitude are difficult for citizens to determine, so we provide that information.

*no paper submitted

Data to Action, Part One: Volunteers Using Their Own Data

Moderator: **Jerry Schoen,** Massachusetts Water Watch Partnership
Presenters: **Mike Herz,** San Francisco Baykeeper; **Lynn Kramer,** Herring Run Watershed Association; **Anne Lyon,** Tennessee Valley Authority; **Tom Murdoch,*** Adopt-A-Stream Foundation; **David Nolte,** BLM Coordinator of Bring Back the Natives Program

Mike Herz
San Francisco BayKeeper

Monitoring for Compliance

State of the Bay

San Francisco Bay, the largest estuary on the West Coast of North America, is under unprecedented pressure from oil spills, filling of wetlands, point and nonpoint source pollution, dredging, and freshwater diversion. Populations of salmon and striped bass are as little as 10 percent of what they were 30-40 years ago. Fish and waterfowl in the Bay often contain quantities of mercury, selenium, and PCBs that make them unfit for human consumption.

Who's minding the Bay?

Although existing legislation gives the impression that the Bay is being adequately monitored and the environmental laws are being enforced, in fact agency budget cuts and staff reductions have resulted in a situation where none of the responsible agencies currently conducts any routine, on-the-water environmental monitoring, surveillance, or enforcement programs. While the EPA-delegated authority, the Water Quality Control Board, once maintained a full-time water sampling patrol boat on the Bay, today the agency no longer even has a boat. And the U.S. Coast Guard's twice-daily Bay pollution patrols were discontinued over a decade ago.

A survey of environmental regulatory agencies conducted five years ago revealed that staff members openly acknowledge that violations of water quality laws often went undetected because their agencies weren't looking, or if they were detected, prosecution was slow or nonexistent because of lack of adequate legal staffs. This mandate without manpower has produced toothless guard dogs.

The San Francisco BayKeeper Program

The San Francisco BayKeeper's mission is to protect, preserve, and enhance the resources and health of the ecosystems and communities of the Bay region. Its objectives are (1) to monitor water quality and report pollution incidents; (2) to serve as an antenna for citizen complaints and as a deterrent to illegal activities on the Bay; (3) to negotiate with and, if necessary, initiate litigation against violators; (4) to monitor the performance of agencies charged with enforcing Bay protection laws; and (5) to create an informed voting constituency which is aware of both the Bay's unique value and its current plight.

BayKeeper program accomplishments

Rather than conducting routine descriptive water sampling, the BayKeeper program focuses on detecting, documenting, and reporting violations of environmental regulations. Although we do no in-house analysis of samples collected by our staff and volunteers, our field work and sampling have been the basis for cases resulting in criminal indictments and jail terms, fines, new regulations to better control stormwater runoff, and health advisories warning of the toxic effects of eating contaminated fish.

- BayKeeper field surveillance, detection, and reporting of illegal, clandestine night dredging of heavy-metal-laden bottom sediment by a shipyard resulted in the first federal criminal indictment and jail terms for executives guilty of a Bay-related environmental crime.
- BayKeeper coliform bacteria sampling at 25 marinas by 40 volunteers led the Water Quality Control Board to institute its own surveys and regulation after a 10-year hiatus.
- BayKeeper monitoring of Army storm sewer discharges to the Bay revealed high levels of bacteria, resulting in Army contracts to identify sanitary sewer cross-connections responsible for pollution.
- BayKeeper detection of shipyard sandblast waste in Bay water samples led to regulatory agency requirement of $250,000 drapes to prevent discharge to the Bay.
- BayKeeper sampling and bioassay test of a cement company's discharge to the Bay revealed water quality violations and resulted in fines and remediation.
- BayKeeper sediment toxicity sampling, fish contamination study, and survey of fishers pressured state public health agencies to post multi-lingual health warnings regarding risks of fish consumption.
- BayKeeper sampling of Golden Gate Bridge District bus yard discharge to the Bay detected persistent oil pollution and resulted in cleanup and abatement.

In addition, BayKeeper staff have responded to more than 550 citizen hotline reports and discoveries by staff and volunteers of spills, illegal dredging, toxic dumping, and other pollution incidents. Using its own boat, as well as volunteers' boats and planes, BayKeeper has covered more than 20,000 miles of San Francisco Bay while patrolling for

* no paper submitted

violations. The program is also directly responsible for stopping ongoing industrial pollution through litigation efforts and has directed nearly $100,000 in mitigation funds to local environmental restoration projects, including creeks and wetlands. Finally, BayKeeper has created heightened public awareness about the deterioration of the Bay through more than 100 local and national magazine, newspaper, radio, and TV stories; distributed our newsletter (BayKeeper Log) to nearly 10,000 people each year; trained many citizen volunteers; and provided technical assistance and advice to potential and existing "keeper" programs in more than 25 locations throughout the country.

For more information about our program, our training manual, training videotapes, or feasibility study, contact us at Building A, Fort Mason, San Francisco, CA 94123; 415/567-4401.

Lynn Kramer
Herring Run Watershed Association

Actions Resulting from Herring Run Stream Survey

I represent the Herring Run Watershed Association. The formation of this association is itself an example of one of the many actions that were taken as a result of data collected by volunteers. This group is a direct outgrowth of a group that, with the support of Maryland Save Our Streams (SOS), organized a data-collection project called a stream survey.

Before I talk about the stream survey, let me give you some quick statistics on the Herring Run. Herring Run is a tributary of Back River, which flows into Chesapeake Bay. For two-thirds of its length the stream flows through Baltimore City, mostly on park land. Herring Run is small enough to be manageable (25-mile combined stream channel length) but large enough to be significant (it is one of three major watersheds in Baltimore City).

The Herring Run stream survey

On October 17, 1992, 100 volunteers gathered to conduct the stream survey. Teams walked one-half-mile stretches of the river to locate the following potential pollution sources:

- exposed sewer lines
- sewage overflow points
- pipe outfalls
- fish migration barriers
- channelized stream sections
- unshaded areas
- heavy trash dumping areas
- in-stream construction
- unusual stream conditions (erosion, sedimentation, etc.)

Actions taken

What resulted from this survey was a document that could be used as a blueprint for action by citizens as well as government agencies. After the stream survey, things have moved very quickly:

October 17 - Stream surveyed by 100 volunteers.

November 18 - Report presented orally to the public. Instead of just showing citizens what problems were discovered, we pointed out all the great opportunities for action—for really making a difference. I need to acknowledge SOS here for their excellent advice, which was to have people move into groups right then and there to meet each other, talk briefly about the restoration project they would plan, and set a date to meet again.

January 13 - Meeting held to establish permanent watershed association (HRWA).

February 10 - Televised City Council hearing. This hearing was an opportunity not only for us to report on what we found but also for the Department of Public Works to report on corrective actions they had begun to take. Presenting to City Council at a televised hearing gave legitimacy to the project and visibility to both SOS and HRWA, and it was the beginning, for HRWA, of some political connections.

May 4 - Written status report sent by Department of Public Works.

Now, a year and a half later, the Herring Run Watershed Association is:

- conducting monthly restoration activities
- making presentations to schools, churches, and community associations
- working with the Department of Public Works, exploring ways in which we can support each other in our mutual goal of improving water quality

Two challenges

The actions I've mentioned are the results of doing the stream survey. In the time that's left, I will briefly address two of the many challenges we face:

#1 = Involvement by people of all ages and ethnic and socioeconomic backgrounds
#2 = Formation of partnerships with government

Challenge #1 - Getting people involved. First you've got to get people to understand that there's a stream nearby. In the city, many people don't realize that fact or they don't make the connection between "stream" and the water they see running over the channelized sections in their neighborhood.

The information we collected about the geography of the Herring Run has been very useful as a first step in educating and motivating people to take action. People are amazed when they see where the Herring Run begins and ends and how the tributaries tie into the main stem. Simply communicating these basic geographic facts to people and showing

them a map brings the *whole* river system into focus, and shows how its parts are interconnected and how it ties in to the Chesapeake Bay. This is very easy to lose sight of in an urban area. People begin to see how they are a part of a nature-based watershed community even though they are surrounded by concrete, brick, and steel. They've got to make this basic connection first before they can be expected to do anything with any kind of water quality data we collect.

Challenge #2 - Forming partnerships with government. We all know that it is important that data collected be as understandable and credible as possible. One way to make that happen is to get advice, guidance, and training from those who have to use the data. Since sewer lines are a large presence in urban streams, HRWA and SOS are currently working with Baltimore City Department of Public Works (DPW), exploring ways to make sure the data we collect is optimally useful to them. In fact, HRWA will be conducting a stream workshop in July in which a DPW representative will participate and answer any questions that come up as we survey a one-mile stretch of stream. We are also looking at using DPW's maps when we do the next stream survey.

Finally, HRWA leaders and several City Council members will be meeting with DPW representatives on May 5 to gain a better understanding of the bigger "sewershed" picture. What is the city-wide picture and how does the Herring Run fit into that bigger picture?

Predictably, I guess, there is resistance from some members of the organization who feel government in general cannot be trusted, certainly not for advice or training. But that degree of resistance is minimal. Most people are cautious but agree that forming partnerships with government is worth trying to achieve.

Certainly, it would have been a whole lot easier to just turn the information we collected over to DPW and hope for the best. After the data are collected, however, is really when the work begins. It is important to ask for written progress reports and updates of those reports until everything you've uncovered has been addressed to your satisfaction, or at least until you feel you've taken it as far as possible. It takes time and energy to do that, and a commitment to follow through.

Three things we did right

Finally, I'll mention three things about the Stream Survey that really worked:

1. Moving people into immediate action when presenting the results.
2. Having a City Councilman involved from the beginning, who championed our cause and set up the televised City Council hearing.
3. SUPPORT, SUPPORT, SUPPORT! My acknowledgment and thanks go to Landmark Education Corporation, Maryland Save Our Streams, Baltimore City Department of Recreation and Parks and Urban Resources Initiative, and "TREEmendous Maryland."

Anne E. Lyon
Tennessee Valley Authority

Profiles from TVA's Teacher/Student Water Quality Monitoring Network

TVA began its Teacher/Student Water Quality Monitoring Network (T/SWQMN) program in 1986 in response to two needs—the need to obtain water quality data on small streams TVA was unable to monitor, and the need to provide teachers and students with a challenging and meaningful education program. The program began with eight very dedicated teachers and evolved into a formal program with its own training manual. From February 1986 through October 1994, 93 teachers, 340 students, and 7 guests were trained in the program. Over 10,000 students have received instruction in water resources concepts through the classes of these teachers.

In 1993, TVA ended its sponsorship of the T/SWQMN. We are currently refocusing much of our effort and financial support on a new project in which interdisciplinary watershed teams, called River Action Teams, identify and solve local water quality problems in Tennessee River subwatersheds. But we continue to encourage school systems to implement the T/SWQMN's approach and adapt it to their needs. Many of the teachers involved in the network have already incorporated the program into their curricula and found alternative sources of funding.

Unlike other water monitoring programs throughout the United States, the focus of T/SWQMN was to train teachers and students to conduct actual water quality studies. Instead of having the participants collect standard information and supply it back to TVA, they were taught to develop a study question, select the appropriate measurements to answer the question, and interpret the data. The result of their work was a research paper submitted to TVA and shared with others in a yearbook. Hundreds of water quality studies were conducted and selected studies have been published in yearbooks. Teachers and students alike have received numerous honors and awards, including scholarships and grants, as a direct result of their participation in the program.

The program was deliberately designed to be very flexible so that participating teachers could adapt it to their specific situation and school system needs. The direction the program took over the years was largely due to the creativity and imagination of our participants. Even though the program was not specifically designed with an action component in mind, many of the teacher/student teams took the program to this level, with great success. I'd like to share with you some of their stories.

Protecting Spotfin Chub

Peggy Huscusson joined the program in the first year, 1986. She and her students from Franklin High School were interested in protecting the endangered Spotfin Chub which resides in the Little Tennessee River. At the time, Franklin

was the fifth-fastest-growing community in North Carolina, and Peggy and her class feared that increased erosion from development was going to seriously impact the local Spotfin Chub population. They began by conducting turbidity studies to evaluate the problem. They discovered that when Nantahala Power and Light (NP&L) discharged water from Porter Dam, the turbidity levels would increase significantly. Peggy and her students decided to educate the local community about the problem and get them involved. Because the stream flowed through two counties in two different states—Macon County, North Carolina, and Rabun County, Georgia—they decided to expand the project to both counties. They got over 50 people involved in collecting water samples along the Little Tennessee and over 500 involved in the campaign to save the Spotfin Chub. Armed with a comprehensive baseline study, they approached NP&L. NP&L agreed to use their data and begin their own study of the problem. Working together, they helped establish a level of 200 JTUs (Jackson Turbidity Units) as a maximum acceptable level in the river when water is released from the dam. Today volunteers continue to monitor water for turbidity. If the turbidity limit is exceeded, engineers at NP&L are notified and the gates to the dam are closed so suspended materials can settle in the lake. As a result of the project, Spotfin Chub habitat below the dam has been protected.

A lifeless creek

Barbara Levi joined the program in 1987. She and her students from Soddy Daisy High School in Soddy Daisy, Tennessee, chose North Chickamauga Creek to study. To their surprise, they found no life whatsoever in the creek, despite water chemistry results showing adequate levels of dissolved oxygen. Determined to find the source of the problem, they moved up the watershed to the top of the mountain, where they found an abandoned coal mine. Over the course of a year, Barbara and her students worked hard to publicize the problem with local residents and politicians and to find funding to reclaim the area. They found a sympathetic ear in the Tennessee State Legislature and were able to get the state to allocate funding to reclaim 100 acres. Today seven species of fish can be found and the land adjacent to one section of the stream has been turned into the North Chickamauga Greenway with parks and canoe launches. The students are currently working to protect a wetland located in the North Chickamauga watershed, which is slated for development, and to get the lower section of the creek, which passes through Chattanooga, included in the greenways project.

Cleaning up an urban creek

Betty Davis (not the actress!) joined the program in 1990. She and her students from University School in Johnson City, Tennessee, noticed their urban creek, Brush Creek, was nearly dead, littered with trash, and badly eroded—so they decided to do something about it. They began by approaching East Tennessee State University (ETSU) and asking them to help with their studies. Then students presented results of their studies to the city and community to solicit support to clean up the creek. Johnson City decided to conduct a formal study of the problems and invited the students to participate. Today a partnership has been formed between ETSU, Johnson City Wastewater Treatment Plant, and the City Stormwater Management Division to conduct this study. In addition to collecting data used in the study, students are currently working to set up a citywide Adopt-a-Stream program and to develop a greenway and parks along the creek.

Students' recommendations implemented

Orpheus Deaver joined the program in 1991. His students from Fannin County Comprehensive High School in Blue Ridge, Georgia, are required to complete an original environmental study as part of their school curriculum. The students mainly study Weaver, Mineral Springs, Hothouse, and North Potato creeks, which extend into both North Carolina and Tennessee. Their studies have ranged from measuring runoff from shopping centers or industry to conducting fish surveys or analyzing new methods to reclaim Copper Basin. The students present their findings in papers to the local alderman and the community. This information is taken very seriously. One student's recommendation to the state to improve erosion control along North Potato Creek is being implemented as part of an ongoing restoration project by the TVA and the State of Tennessee. The class is currently working with Fannin County to monitor the effects of constructing a new middle school, to assure that water quality in the adjacent creek is not compromised.

Dealing with sewage contamination

Mark Stallings joined the program in 1992. He and his students from Gilmer High School in Ellijay, Georgia, won the 1993 Seiko Youth Challenge environmental competition for their work cleaning up Cox Creek. During months of field testing and lab analysis, they found high concentrations of fecal coliform in the creek. Tests indicated the primary source of the coliforms was from failed septic tanks of homes adjacent to Cox Creek. Students also identified a separate but related problem of leachate escaping from an old landfill near the creek. To clean up the creek, students decided to "set their sights on the politics of the problem and find a creative solution." Persistence worked. Enlisting the aid of Georgia Governor Zell Miller, the students became a part of the Ellijay/East Ellijay–Gilmer County Comprehensive Planning Committee and have applied for a Community Development Block Grant to fund their proposal to link a new sewage pipeline to the landfill and houses along Cox Creek so wastewater will flow to the city's wastewater treatment plant. Steps to secure financing are under way.

What works, what doesn't

When asked what made the program work for them, teachers suggested:

- Use a scientific study approach—it is easier to sell to administrators and to incorporate into the curricula.

Encourage students to form a hypothesis and not to jump to conclusions. Not all streams are polluted!

- Let students decide what to study. Resist the temptation to impose your own ideas. If they are working on a problem they care about, they will follow it to some resolution.
- Involve other agencies on the front end and ask for their input. Agencies that have been involved are more apt to accept results of the study and work to resolve any problems found.
- When students finish a study, encourage them to temper their emotions, report their findings as information, and offer alternatives to resolve the problem. This keeps the school out of trouble and works better with elected officials, company presidents, and the community.

When asked what got in their way, teachers cited:

- Lack of time.
- Students graduated, and often interest in the project went with them.
- Teachers' interests changed and/or they got burned out.

Surprisingly, opposition from school principals, school boards, or local businesses/industry was not considered a barrier by most teachers.

Teachers had several words of advice to give others who are considering monitoring streams and getting the community involved:

- START SMALL!
- Use data, not emotion, to introduce the community to problems.
- Let the community take ownership of the problem and support any cleanup or protection efforts.

Good training, access to water quality professionals, and a sound scientific approach enabled these teachers and students to reach beyond their schools and really make a difference.

David A. Nolte

Trout Unlimited/Bring Back the Natives Coordinator

Data to Action with Trout Unlimited

"Data to action—volunteers using their own data" is a theme found throughout the history of Trout Unlimited (TU). In 1959, a small group of Michigan anglers formed an organization that would grow to over 70,000 members, with more than 400 chapters across the nation. Today, Trout Unlimited serves as a coldwater fisheries conservation organization. Because trout and salmon and their habitats are inextricable parts of larger ecosystems, effective resource advocacy now must address even greater threats to the integrity of those ecosystems including water pollution, hydropower, wetlands destruction, grazing, and logging.

Some rural perceptions about water quality

Many of our members live and work in predominately rural areas. Rural perceptions regarding water quality sometimes differ from an urban resident's concerns. Rural residents are often concerned about the effects of sediment, water temperature, and quantity of water. For example, drought means smaller shares of water for users, and native aquatic species are most often last in line. Farmers and ranchers may not be as concerned about water temperature but rather water quantity for their crops or cattle. An angler might be concerned about both water temperature and quantity for the support of salmon, steelhead, and other salmonids to enjoy recreational angling or wildlife viewing.

Trout Unlimited programs

Currently, TU's National Fishery Resource Programs include the Agency/Angler Sport Fish Restoration Program, Bring Back the Natives, Embrace-A-Stream, Forest Service Partnership, and Watershed Conservancy. Four of these five programs often involve professional advocates, scientists, and grassroots volunteers in projects that directly involve the collection, analysis, and dissemination of water-quality-related data.

Embrace-A-Stream

Trout Unlimited annually commits approximately $100,000 of funding to its own chapters under the Embrace-A-Stream grant program. Through a process of application and evaluation, projects are selected that support fishery resource research and education projects.

An outstanding example of water quality and watershed oriented activities can be found in one Embrace-A-Stream project selected this year, the "Phase III of Budd/Deschutes Project GREEN" submitted jointly by the Olympia Chapter of Trout Unlimited and TU Northwest Steelhead and Salmon Council. This project's mission is "through community-based watershed studies, to develop a local citizenry with the knowledge, skills, and motivation to act collaboratively on local environmental challenges and create globally sustainable lifestyles." The project is bringing together schools and communities to improve water quality, enhance fisheries and wildlife habitat, study watersheds as ecological systems, link diverse publics and officials, develop informed citizenry, and promote empowerment of their volunteers. Key elements of this project are water quality monitoring (chemical, biological, and physical), interdisciplinary investigation of the watershed, computer communication, community service/action projects, and a Student Congress.

During the 1992/93 school year, 27 classes from four school districts in the Budd/Deschutes watershed monitored the river system for nine water quality parameters and made an inventory of physical characteristics. The data collected permitted comparison from different sites in the watershed. The monitoring data collected also included information

about cultural, economic, and environmental aspects of the watershed. Students identified and prioritized their issues and then worked with community members or groups such as Trout Unlimited to plan and implement a natural resource "action" project. Action projects include such activities as revegetating riparian zones, stenciling storm drains, clearing garbage from streams, devising community awareness programs for water quality, and making presentations to local officials.

Bring Back the Natives

In 1992 TU began its involvement with Bring Back the Natives (BBN). This key national fishery program is the first national campaign combining two major federal agencies, the USDA-Forest Service and USDI-Bureau of Land Management, with partnerships including state agencies, local organizations, private businesses, citizens and landowners, and TU. The program focuses on restoring the health of riverine systems and the repopulation of native freshwater species. Currently there are 28 BBN projects across the nation. Each of these projects offers to citizens an opportunity to be involved with restoration of watersheds and water quality. Watershed analysis, site surveys, data collection, pre and post monitoring of restoration projects, scientific research, and public education are all tasks where volunteer data are used.

As an example, the BLM Prineville District, located in Prineville, Oregon, is supporting a watershed education program, Crooked River Ecosystem Education Council. This program is jointly sponsored by BBN and the Ochoco National Forest. Volunteer and partnership opportunities include riparian restoration projects, special status species monitoring, and recreational fishing enhancement.

Currently in the Prineville District, 65 water temperature data loggers are deployed in the John Day and Crooked River watersheds, over 500 river miles. Volunteers have been used for collection of temperature and fishery-related data with both BLM and USFS Ochoco National Forest personnel. However, more support is needed for collection of water quality data in conjunction with temperature and turbidity measurements. Citizen-collected data are compiled by both professionals and citizens, with data analysis and error checking by professional staff. Gifted students from Crook County High School have been involved with computer programming and database design for data analysis. Water quality data are used for management planning and strategies for salmon and trout and to meet Oregon Department of Environmental Quality guidelines.

Changing agency attitudes

I think we are beginning to see changes in the agencies. The Forest Service is opening up to citizen involvement. In closing, let me share with you an example of the direction agencies are heading. A BLM Fish Biologist, David Young, whom I have the pleasure of working with, told me he believes that "a national goal for resource management should include citizens directly involved with all aspects of resource monitoring, particularly water quality; that citizens must strongly be involved in defining management goals on an ecosystem basis (watershed level approach) so that each and every one of us understands that, for a particular watershed, *here is the water quality goal.*"

Assuring Quality Data

Moderator: **Kathleen Ellett,** Alliance for the Chesapeake Bay
Presenters: **Kathleen Ellett; Martha Cheo,** Adopt-A Stream Foundation; **Gayla Campbell,** Texas Natural Resource Conservation Commission; **Linda Green,** University of Rhode Island Watershed Watch; **Julie Rector,** Washington Department of Ecology Citizen Lake Monitoring

Kathleen Ellett
Alliance for the Chesapeake Bay

Opening Remarks

The presentations and discussion today are intended to convince you of the importance of carrying out the spirit of your QAPP (Quality Assurance Project Plan). Naturally, we are assuming that you have one!—or are planning to prepare one—especially since it is required for any project generating data with EPA financial support.

We will not be addressing the step-by-step preparation of QAPP's but we can provide references to already-prepared plans. For actual details and written guidance, you should contact your EPA Regional Quality Assurance folks.

Let's begin with some overall definitions (more definitions will be given by our panelists).

QUALITY ASSURANCE (QA) is the overall strategy to ensure high standards throughout the program. It includes the planning, implementation, and final analysis and reporting—in short, everything done by anyone connected with the project from start to finish!

QUALITY CONTROL (QC) is a piece of quality assurance. It encompasses those procedures used during a particular analysis which make that analysis more accurate and precise.

QUALITY ASSESSMENT involves the continuing evaluation of your QA/QC program.

The process of preparing a QAPP begins the minute you start planning your monitoring project, and the first step in planning is identifying your **Data Quality Objectives.** DQO's, as they are referred to by the cognoscenti, are specific integrated statements and goals developed for each data or information collection activity to ensure that the data are of the required quantity and quality. They should specify the desired sensitivity of sampling methods, timing and location of sampling, and the number of samples to be collected.

When forming the data quality objectives, the planning committee should closely examine the program budget. While sophisticated analyses generally yield more accurate and precise data, they are also more costly and time-consuming. If the program's main goal is to supplement state-collected data, the planning committee may determine that this extra expense is worthwhile. Programs with an educational or participatory focus can often use less sensitive equipment, analyses, or methodologies and still meet their data quality objectives.

Winding up my remarks, I remind you of the overall theme of this conference—"putting our data to use." We have convinced most folks that volunteers can collect data that are of good and known quality, but we are faltering when it comes to data analysis and reporting. Potential data users, particularly state agency staff, simply cannot handle the data overload. They want to see interpretive reports—not just numbers, or even just graphs and plots. They need to know all the hairy details of how the data were collected. They want to be able to read narrative that synthesizes the results and tells them what the particular water body is like and identifies its problems. They can then use the plots and figures to document the accuracy of our conclusions.

Martha Cheo
Adopt-A-Stream Foundation

Quality Assurance for Benthic Macroinvertebrate Monitoring

This presentation will outline the basic quality assurance points to consider when using macroinvertebrates (hereafter referred to as "bugs") as a tool for assessing the health of stream systems. It will not go into detail about bug collection and analysis methods, as this is the focus of other conference sessions (see especially Session 2, "Macroinvertebrate Monitoring").

Study coordinator

For any water quality study, it is important to develop the role of a coordinator who is responsible for the overall management of the program. Plan ahead for turnover; take care to ensure that the coordinator position does not disappear if the person moves on. The coordinator should oversee the selection of study sites, to make sure they are comparable and adequately represent the focal issues of the study. Other roles of the coordinator may include recruiting and training volunteers, ensuring that all are trained in the same methodology and use the same equipment. The coordinator also should organize a technical advisory committee that can help guide the study and provide quality control checks for the program.

Technical advisory committee

The technical advisory committee should be composed of (a) aquatic biologists familiar with bugs in the region of the study and (b) the individuals and agencies that will be using the data to make decisions. This means both landowners (the ultimate resource managers) and agency staff from the city, county,

state, and other jurisdictions through which the stream flows. If the study is designed in cooperation with the data users, the chances are much greater that the data can and will indeed be used. The technical advisory committee can help determine the goals of the study, review the study design and site selection, train volunteers, provide quality control checks on protocols, interpret results, and make recommendations for action.

Study design

The process of designing a monitoring study using macroinvertebrates is discussed in detail in the workshop on "Macroinvertebrate Monitoring" (in Session 2). Following are a few points about study design that are particularly critical to quality assurance:

1. Collect the samples at the same time each year.
2. In selecting reference stream sites, "all else being equal" is a must. This means that each reference site should be of the same order as its counterpart site on the study stream and that characteristics such as gradient, substrate, flow, pool-to-riffle ratio, and riparian condition should be comparable (unless the impact of one of these characteristics is the focus of the study).
3. Document site locations in writing and mark them in the field.
4. Standardize a site evaluation procedure. Ideally sites should have the following characteristics:
   - cobble/gravel riffle
   - velocity of 0.4 - 2 feet/second
   - depth of 0.5 - 4 feet
5. Have site selection reviewed and field-checked by the technical advisory committee.

Field collection methods

Bugs can be collected with a Surber sampler, kick net, or D-net. Surbers provide the most precision because their frame standardizes the actual area of the stream bottom that is sampled. A mesh size of 0.6 mm is recommended for best results; anything smaller gets clogged, while anything larger may allow smaller bugs to escape.

After all cobbles and larger gravel pieces are brushed off carefully and set outside the sampling area, the underlying substrate should be disturbed thoroughly. Relying on a set time duration (e.g., 60 seconds) of disturbance does not yield as consistent results as simply disturbing the area thoroughly. Different volunteers with differing leg strengths will disturb the substrate to different extents within the same time duration.

For each study site, three replicate samples from three different riffle areas should be collected. For the best completeness, make sure the samples are composites of slow and fast areas in each riffle. Each sample should come from a total of about one square meter. The exact size is not as important as consistency; just make sure that all samples come from the same area of disturbed substrate. The technical advisory committee can take duplicate samples at the same sampling sites, analyze them separately, and check the consistency of the volunteers' results with their own.

Analysis methods

If only a simple presence/absence analysis is required, it can be conducted in the field and organisms can be released back to the stream when sorting and counting are completed. Setting up tables and chairs in the field will help make volunteers more comfortable, which translates into a higher level of patience and thus greater precision and accuracy. Even if bugs are released back to the stream, a representative specimen of each distinguishable taxon should be preserved for later verification by the technical advisory committee.

If a more detailed analysis is required, samples should be preserved with a 90 percent alcohol solution and brought into a laboratory facility with dissecting scopes. Pre-label sample jars to reduce the chances of unidentified or misidentified samples. For each study site, the abundance (density) of each family group is averaged over the three replicate samples.

One issue that should be considered in a discussion of quality assurance is the fact that taxa richness increases with organism density. To control for this, pick a subsample of a standard size (100-organism subsamples work well). Use the subsample to determine the density of each family taxon. Shallow white trays marked with a grid pattern of equal-sized squares work well for picking a subsample.

Another way to ensure quality in the lab analysis is to have volunteers give each other quality control checks as they sort and count samples. For example, after one person has picked all the organisms from one square in the grid, have a second person double-check the square to make sure no organisms were overlooked. Keep a reference "library" collection of bugs on hand, clearly labeled, so volunteers can use them as they identify bugs in the samples. The technical advisory committee can provide a quality control check by reviewing the completed data forms and preserved samples.

Remember that higher density and even higher taxa richness does not necessarily mean a stream is in better shape. An increase in density and richness could result from nutrient pollution, especially in smaller headwater streams.

Training

Training sessions should occur both in the field and in the lab. Trainers should give volunteers ample time to practice. Volunteers can be observed while practicing. Trainers should also give volunteers time to practice alone, then check their work when completed. Trainers should set up demonstrations of commonly confused taxa so volunteers can more easily pick out the subtle differences by viewing them side by side under the scopes.

Volunteer roles

Distribute volunteer roles in a way that decreases possibilities for inconsistency. Each *type* of data should be generated by the same team of volunteers. For example, have one team

do the bug sorting and counting for all sites, another team do the habitat assessment for all sites, and a third team do the water quality assessment for all sites, if possible. This would yield more comparable data than having one team generate all data for one site, another team generate all data for a second site, etc.

Gayla Campbell
Texas Watch, Texas Natural Resource Conservation Commission

Some Quality Assurance Pointers

QC exercises

Carrying out QC exercises (often called QC sessions) with volunteers helps ensure that the data collected are meeting the *precision* and *accuracy* values stated in your data quality objectives. QC exercises are mandatory for programs using federal funds. Be sure that the sessions evaluate both the accuracy of the equipment and the precision of the volunteer monitors' technique.

Most programs require that volunteers successfully complete two sessions a year. The exercises include both field and laboratory evaluations of equipment, personnel (i.e., the volunteers), and procedures. They also include brief written reports on the results, including any necessary corrective actions. Some programs carry out both field and laboratory exercises on the same day; others hold them on separate days. Field sessions provide an opportunity to check not only precision and accuracy but also field protocol, safety, and behavior.

Programs that do not require QC sessions run the risk of collecting data of unknown quality, which will be of little value to data users.

Tips

Following are some tips on carrying out QC exercises:

- Schedule the first session three months after volunteers begin sampling. This allows you to resolve initial problems early in the program.
- Schedule more sessions than the number volunteers are required to attend.
- Develop a "user-friendly" session. Don't let volunteers feel they need to worry about "failing" the tests.
- Choose a location with sufficient light and space, and areas for preparation and cleanup.
- Make the most of the time together. Invite a speaker or tour a plant.
- Prepare a list of coordinator tasks to be done before and during the session.
- The equipment used to determine known values need not be an expensive multiparametric meter. However, if a kit is used, it should be one used only by the coordinator and should have fresh reagents.
- Above all, instill in volunteers a sense of the importance of their participation in these sessions to the overall success of the program and use of the data.

Examples of classroom exercises

There are two general approaches to classroom sessions:

1. Attendees do the required tests on the same water sample, using their equipment, the same way they would carry out tests at their site.
2. Attendees read and record results from pre-set stations (similar to a laboratory "practical").

In either case, the difference between the volunteers' measured values and the known value should be within the acceptable limits for precision and accuracy stated in the program's DQOs.

If the exercise is conducted like a lab practical, the following setup is recommended:

Station 1 for equipment check (working order, fresh reagents) using the volunteers' own equipment.

Station 2 for evaluating the accuracy of the volunteers' equipment, using known solutions. Station 2 can also include a place to check Secchi disk line markings.

Station 3 for evaluating both accuracy of equipment and precision of volunteers' procedures. Volunteers use their own equipment to complete the required tests on the same water sample. (A large bucket or cooler of tap or river water is used. All volunteers test from that container.) The coordinator will either take readings from an electronic instrument in the bucket or run tests with his or her own test kit to provide a "known value" from which the volunteers' values will be checked.

Calibration of kits and electronic equipment

Calibration procedures check equipment results against a known value. Here are a few general tips on equipment calibration:

- Check on calibration procedures before purchasing equipment.
- Document all calibration procedures and the resulting data.
- Ensure standards are fresh and are appropriate for equipment ranges.
- Always precalibrate instruments within 24 hours before use.

Thermometers should be calibrated before their first use and checked for accuracy at QC sessions. Calibration should be done both at room temperature and in ice bath waters. The "standard reading" should be done with a National Institute of Standards and Technology (NIST) certified thermometer or other calibrated meter. Thermometers outside the accepted range (± 1.0°C) should be discarded.

Hydrometers should be calibrated prior to use. They do not need to be recalibrated, but should be checked at QC sessions. Calibration can be done in real or artificial seawater. Include low, medium, and high readings. Reject those that are

outside the accepted range.

Meters should be calibrated according to manufacturer's instructions. In addition, other maintenance and proper storage and handling should be followed to ensure testing accuracy and prolong usefulness of the equipment.

QA activities in a large monitoring program

There are some special problems associated with carrying out quality assurance in a large program like Texas Watch. With a large program, communication is the key. The pyramid approach to carrying out activities at the local level is essential. Recruit and train partners and dedicated volunteers to be trainers and quality assurance officers, and to provide timely feedback to volunteers. This process also unites communities in working toward common goals.

Development of standard letters, reporting forms, testing and QA procedures, and training session guidelines is extremely important to gathering high-quality, usable data. In addition, develop a database program that volunteers can use to input their data, then send it to the partner, who in turn sends it to the program office. This allows for use of data at many levels.

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The "PARCC" Parameters

There are many facets to developing and implementing a quality assurance program and a quality assurance project plan. This paper deals with one aspect of that plan—the five terms, collectively known as "data quality indicators," that are used to assess quality: precision, accuracy, representativeness, comparability, and completeness ("PARCC"). These terms are often confused or misused.

One assumption of this paper is that you as a volunteer monitor will be making more than one measurement. One data point is nearly useless, since neither you nor the potential data user has any idea how close or far that measurement is from the true value. In general, when multiple measurements of a parameter are made they will not all be the same. If you were to create a graph by plotting on the x-axis the results of your measurements, and on the y-axis how frequently each of these results occurred, your graph would ideally have the shape shown in Figure 1. This bell-shaped curve is known as a "normal" or "Gaussian" distribution. The highest point on a normal curve is the mean or average occurrence. In the rest

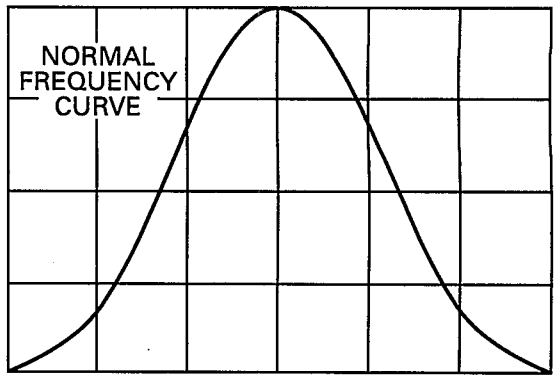

Figure 1. Normal curve.

of this paper I will use this graph to illustrate some of the concepts of the five PARCC parameters.

1. Precision

Precision is a measurement of how close data points are to each other. Other terms for precision are "repeatability" or "replicability." They all refer to the measurement of random variation in data.

Precision is measured statistically by calculating the "standard deviation." Many hand-held calculators have been preprogrammed to calculate the standard deviation. The standard deviation is an indication of the range of variation in the measurement. If you have fewer than 10 measurements, the range of the data (the biggest measurement minus the smallest) is a reasonable estimate of precision.

Even more useful is the calculation of the coefficient of variation (also known as the relative standard deviation). To calculate, divide the standard deviation by the average of the

The PARCC Parameters

1. **Precision** - a measure of how close data points are to each other, usually expressed by standard deviation or coefficient of variation.
2. **Accuracy** - a measure of how close data are to the "true value."
3. **Representativeness** - the degree to which data accurately and precisely represent environmental conditions.
4. **Completeness** - the amount of valid data obtained compared to the amount that was expected to be obtained; usually expressed as a percentage.
5. **Comparability** - expresses the confidence with which one data set can be compared to another.

Two additional terms that are important to any discussion of the above terms are:

Sensitivity - the smallest increment that can be determined with confidence.
Detection limit - the lowest concentration that can be reliably detected.

data, and multiply by 100. A large coefficient of variation means that the measurement is less precise, a small one that it is more precise.

Suppose each of the three members of a monitoring team makes a certain measurement five times. After the measurements have been made they perform some simple statistics. The results are shown below:

	Monitor A	Monitor B	Monitor C
	2	1	1
	3	2	2
	3	3	2
	3	4	2
	4	5	8
Mean	3	3	3
Range	2	4	7
Std.Dev.	0.7	1.6	2.8
C.V.	23%	53%	94%

Looking at the range of data, Monitor B's data are twice as variable as A's, and C's data are almost four times as variable as A's. As expected, both the standard deviation and coefficient of variation are the smallest for Monitor A. The coefficient of variation gives a more meaningful interpretation of the general results.

Conceptually, as the precision of the data declines the "bell-curve" becomes lower and flatter. However, all these measurements say nothing about the accuracy of what is being measured. The difference between precision and accuracy is illustrated in Figure 2.

2. Accuracy

Accuracy is determined by analyzing a sample of known concentration and comparing the results to the "true value." Accuracy is also known by the terms "bias" or "relative error." Accuracy is computed statistically by the following equation:

$$100 \times (\text{true value} - \text{actual value}) / \text{true value}$$

What if you don't know the true value? This is the case with the measurements in the above example. The precise measurements of group A are no more indicative of the accuracy of the measurements than are the imprecise measurements of Group C. Without any supplementary information we have no idea which is the most accurate value.

There are a number of monitoring situations in which it is difficult to ascertain the true value of a measurement—for example, using a Secchi disk to measure water clarity. In such cases, the most practical solution is to make a number of measurements, average them, and state that no estimation of the accuracy can be made. URI's Watershed Watch program uses experienced volunteers to help assess the quality of new volunteers. When we compared Secchi disk measurements on a number of locations and with a number of different teams of mentors and new volunteers (Figure 3), the mentors' and new volunteers' readings were very closely matched. This indicates the accuracy of the measurements even though the "true value" remains unknown.

If volunteers are using a test kit (for example, to measure dissolved oxygen or pH), there are more options to help ensure the accuracy of the measurements. The group may purchase or borrow an analytical or laboratory-grade meter in order to compare kit results initially and during QC sessions. An alternative would be to see if a local analytical or university laboratory might agree to compare the kit results with their equipment. If the measurement is being used solely to detect a trend, using the kit alone might be sufficient. The choice is dependent on the group's data quality objectives.

3. Representativeness

This data quality indicator addresses the issue of whether the data accurately and precisely represent the actual environmental conditions. This is not easily determined because errors can be introduced in any number of places, from choice of monitoring location to sampling containers to sample holding to lab errors to data entry errors to calculation errors.

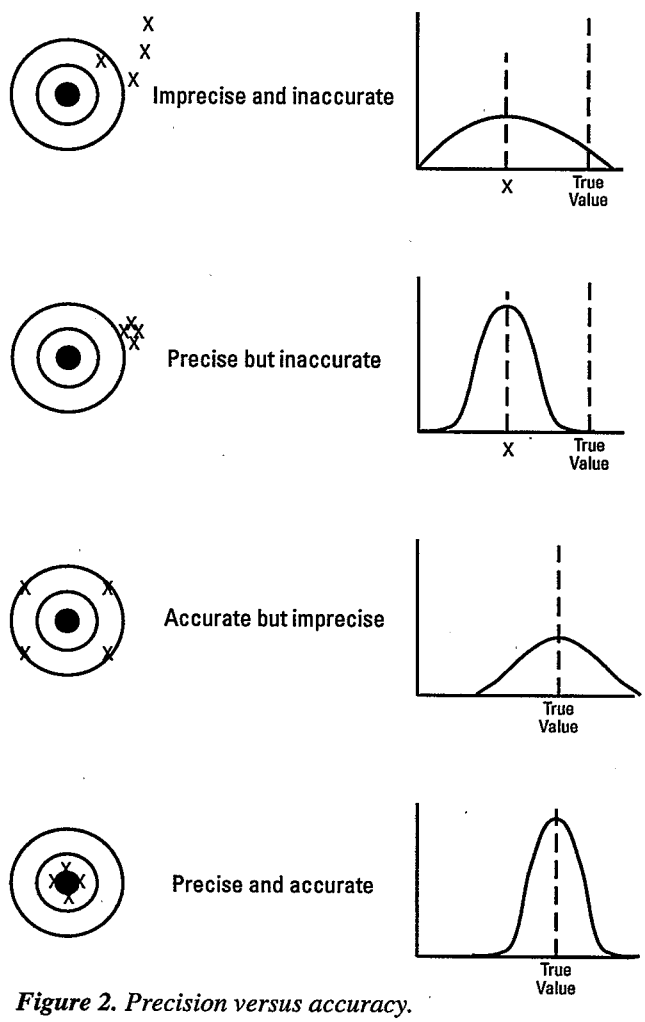

Figure 2. Precision versus accuracy.

It is important to provide clear instructions for where and when to collect samples, how many samples to collect, what to collect them in, and how they are to be treated once they have been collected. In general, as the number of samples increases the amount of bias or inaccuracy decreases. Here are a few of the ways that a sample can become unrepresentative:

A sample may become unrepresentative by virtue of the choice of **sampling location**, also known as the **sampling design** or **sampling scheme**. There are three general types of sampling schemes: judgmental, systematic, and random. Judgmental sampling indicates that you may be drawing a conclusion by selecting where you will monitor, such as in the deepest part of a lake, or at a site where you suspect a problem. While this is the least statistically valid scheme, it is also usually the least expensive. Systematic sampling involves making a measurement at certain intervals. The intervals may be in space, such as sampling every 50 feet, or in time, such as sampling every other Saturday. Random sampling is the statistically best choice, and may be required for legal purposes. It usually costs the most. An example of random sampling would be to set up a grid on a map of your area of interest, assign a number to each of the squares in the grid, copy the numbers on pieces of paper, and have someone select a number of the pieces of paper. The sites monitored would be sampled solely according to the numbers chosen. If you are concerned about a particular area, one obvious drawback with random sampling is that your area of concern may not even be monitored.

Sampling devices themselves can introduce errors. For example, if you are interested in measuring the dissolved oxygen content of a body of water, you must not use a pump to collect the water, since the turbulence of the pumping can introduce air into the water. Remember, the possibility of contamination increases as the concentration of the parameter decreases. It is much easier to contaminate something being measured at the part per billion level than at the part per million level!

The choice of **sample container** and how it is cleaned can be crucial. Texts such as the American Public Health Association's *Standard Methods for the Examination of Water and Wastewater* provide detailed instructions. Some pointers: Don't wash with phosphate detergents if you plan to measure phosphorus, and don't use containers rinsed with nitric acid (used to prepare containers for metals analysis) for the measurement of nitrates in water. Acid-washed glassware that has not been allowed to equilibrate in distilled water may absorb metals or salts out of solution, decreasing their apparent concentration.

Sample handling and transport can be equally critical. Certain analyses, such as those for pH and for bacterial indicators, must be initiated within hours after sampling. Water samples generally should be kept cool and in the dark to prevent acceleration of chemical reactions or degradation of biologically sensitive materials.

4. Completeness

Completeness is the percentage of valid data obtained as compared to that expected to be obtained under normal conditions. It is rare for volunteer groups to collect 100 percent of data. Sampling sites may be inaccessible at certain times of year, there may be equipment failure or breakage, or samples may be spilled during collection, handling, transport, or analysis. Depending on the group's data quality objectives it can be acceptable, for example, to expect to receive 80 – 90 percent of Secchi depth and water temperature data, since sampling dates may be missed due to illness, vacations, or even hurricanes!

5. Comparability

Comparability is a measure of the confidence with which one group's measurements can be compared to another. Types of comparison can include: (1) locations of sampling sites (for example, if all lake sampling stations are located over the lake's deep spot, each program has the same probability of collecting a representative sample); (2) parameters measured as well as units of measurements used; (3) procedures and methods for sample collection and analysis; and (4) how data can be compared (statistically) among programs in terms of precision and accuracy.

In many ways poor data are worse than no data at all. Every time a monitoring group makes a measurement and draws a conclusion from that measurement they are placing their credibility on the line. As we all know, it is much more difficult to restore credibility than to maintain it. The time and effort spent addressing these five data quality indicators will serve to document not only your procedures, but also the expectations you have for your monitoring program.

For further information:

American Public Health Association. *Standard Methods for the Examination of Water and Wastewater.* American Public Health Association, 1015 Fifteenth St. NW, Washington, DC 20005. The "bible."

Hach Company. "Quality Corners" in *Hach News and Notes for the Analyst.* Hach Company, PO Box 369, Loveland, CO 80539. 1-800-227-4224. This quarterly publication has very concise explanations of statistical terminology and how to use it.

Helsel, Dennis. 1990. Less Than Obvious: Statistical Treatment of Data Below the Detection Limit. Reprinted from *Environmental Science and Technology* 24 (12): 1766-1774. Complex but readable.

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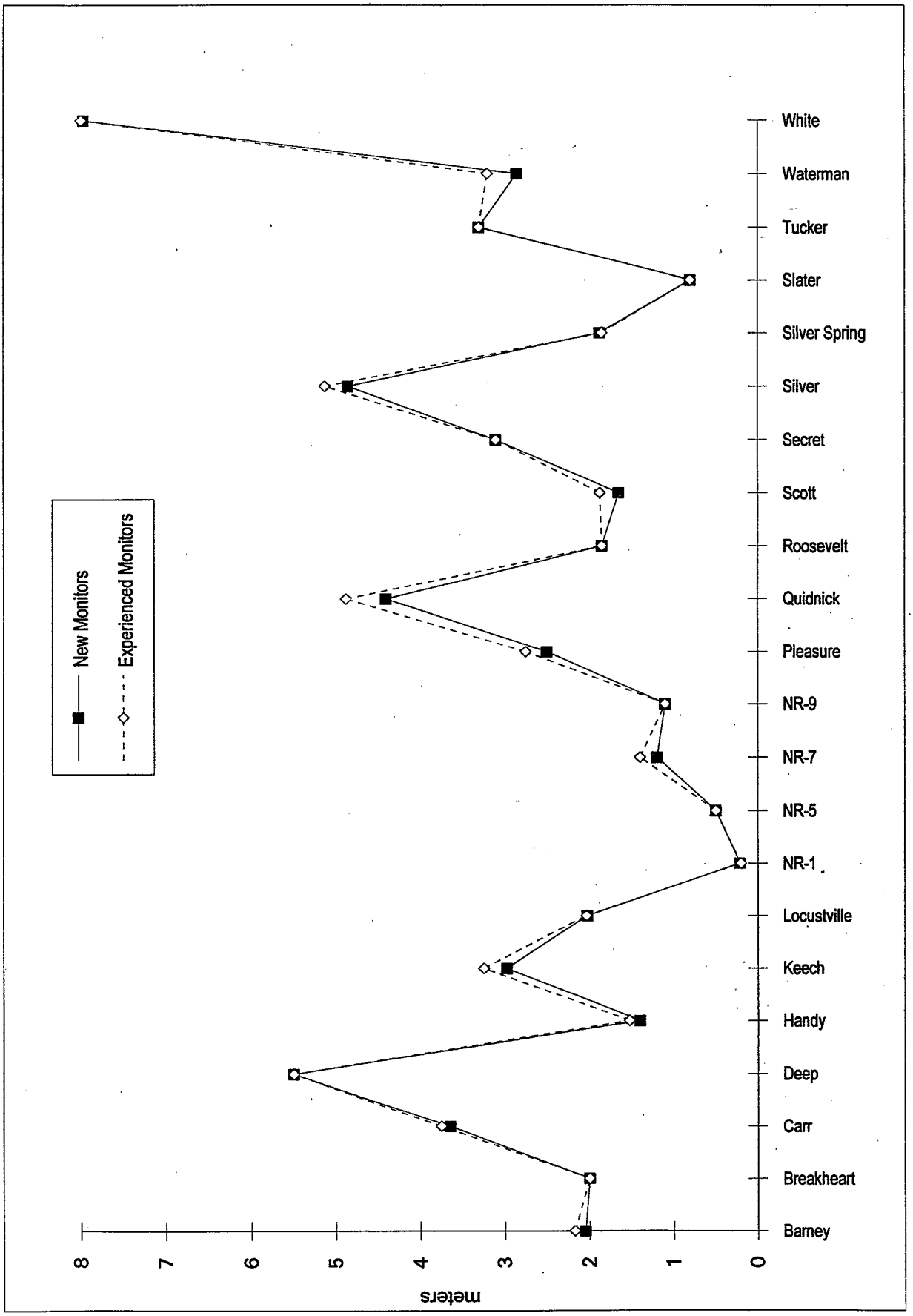

Figure 3. Secchi depth measurements on 22 lakes: New monitors vs. experienced monitors

DC. 1-800-227-5558. ISBN #0-8412-1173-6. 450+ pages.

Kelley, Thomas, et al. *Basic Statistics for Laboratories: A Primer for Laboratory Workers.* Van Nostrand Reinhold, New York. ISBN #0-442-00456-7. 175+ pages.

U.S. EPA. *Volunteer Water Quality Monitoring: A Guide for State Managers.* #EPA 440/4/90-/010. USEPA Office of Water, Washington, DC 20460.

Julie Rector

Washington State Department of Ecology Citizen Lake Monitoring Program

Quality Assurance Samples

Because monitoring data can be affected by many sources of sampling and analytical error, quality assurance project plans must specify the acceptable range of variability in data results. In order to be able to evaluate the extent of variability in our data, we must plan on collecting and analyzing quality assurance samples.

Quality assurance samples are collected both in the field and in the lab. Following is a summary of the various types of samples and the uses of each.

Field quality assurance samples

1. Field replicates

a. For **samples:** To collect a field replicate for a sample, you merely repeat the sample collection process, filling a second sample bottle. Replicate samples should be collected for all parameters that are analyzed for the program, whether they are analyzed by a lab or by volunteers. Sample replicates should be chosen to represent the range of results expected from a program. For example, if dissolved oxygen samples are collected from several depths of a stratified lake, replicate samples should be collected from the bottom of the lake as well as from the surface.

A general rule is to collect field replicates from at least 10 percent of the sampling sites. However, if relatively few samples are collected over a season or a year, you can't really evaluate the variability in the data with only two or three replicate samples. Therefore, smaller monitoring programs ideally should replicate at least 20 percent of their samples.

Results from field replicates are among the most important data quality indicators, because they give an estimate of **total variability**—that is, they include variability in the water body (such as "slugs" of pollutants moving downstream, or algae growing at various depths and areas in a lake) plus variability in both sampling and analytical procedures. If total variability is high, it is important to have lab quality control data to determine whether the analytical procedures are contributing a large amount of variability.

b. For **field measurements:** Field measurements should also be replicated on a regular basis. Temperature, pH, and Secchi disk transparency are easy to duplicate without involving extra analytical costs. For Washington's Citizen Lake Monitoring Program, volunteers replicate their Secchi depth measurements every sampling day. Although this is not a true estimate of precision (since the second measurement is likely to be biased by knowing the first), the replicate results do indicate when there is *variability*—either from the volunteer or from field conditions. Thus, we have greater confidence in the measurement when both measurements are very similar.

Replicate field measurements are also used to evaluate the precision of field equipment. For example, the Wisconsin Self-Help lake monitoring program discovered problems with the precision of a pH pen when replicate measurements were collected.

2. Field splits

A field split is collected by collecting a water sample, mixing it (either in the water sampler or in a separate container), then filling two water sample bottles. The second sample bottle is usually given a made-up site name, so that lab analysts have no idea that the sample is a duplicate. As a result, field splits can be used to get a "blind" assessment of a lab's precision. Some volunteer programs also use field splits in quality assurance sessions with volunteers, to compare the results from a volunteer with results from the program coordinator or trainer.

Because there are limits to the number of lab quality control checks that can be run for chlorophyll analysis (for example, you can't run a lab duplicate on a chlorophyll filter), monitoring programs that sample for chlorophyll should collect field splits in addition to field duplicates to help evaluate total precision. Because of the wide natural variability in chlorophyll results, volunteers with Rhode Island's lake monitoring program filter three split samples which are then analyzed for chlorophyll *a*.

3. Field blanks

A field blank, also known as a transport blank, is made by filling a sample bottle with distilled deionized water, transporting the bottle and opening it in the field, and then having the sample analyzed with your batch of collected samples. Results from field blanks will indicate if there are problems with contamination introduced in the field or from the sample container.

Generally, field blanks for analysis by a commercial lab are prepared only when the parameter requires low detection limits (such as phosphorus or metals), or when you suspect a problem with sample contamination. Preparing one or two field blanks per monitoring season is usually adequate to screen for possible contamination problems.

When samples are filtered before analysis, filter blanks should be prepared. Filter blanks are prepared by filtering distilled water (or, for marine monitoring programs, filtered

seawater) through the filtering apparatus. At least two filter blanks should be prepared per monitoring season; one is prepared before filtering the actual field samples, and the second is filtered after finishing with the field samples. Results from the filter blanks indicate whether the filtering equipment is contaminated, and whether filtering technique includes adequate rinsing.

Lab quality control samples

Even if an outside lab has a good QC program, that lab's QC requirements may not always agree with a volunteer monitoring program's QC requirements. Selection of a lab to analyze samples should be based on whether the lab (1) is familiar with analyzing the type of samples you are collecting (for example, marine vs. freshwater samples), (2) can meet your data quality requirements for detection limits, precision, and accuracy (based on the method you will use to calculate each of these; note that not all labs calculate detection limits the same way!), and (3) uses appropriate analytical and calibration methods for the range of concentrations you expect in your samples. After samples are analyzed, lab performance is usually evaluated using results from lab replicates, lab check standards, matrix spikes, and blanks. Monitoring programs may also submit audit samples to augment QC data for their program.

1. Lab replicates

Lab replicates are "splits," meaning that two portions from a sample are analyzed separately. For most parameters, labs will routinely analyze lab replicates. If you have stringent data quality requirements, you can specify which samples you want the lab to replicate. For example, when I am sampling lakes for Washington State's lake assessment program, I specify 10 total phosphorus samples that I want the lab to analyze in replicate—this way, I know that the lab is not replicating my transport blank samples, and that the replicates analyzed represent a range of low, medium, and high concentrations.

Results from lab replicates are used to estimate laboratory precision. Although the results from the split samples may be expected to be identical, in reality there is usually some difference between the two values, especially for sample analysis that involves complex chemical reactions or very low concentrations of analytes. Ask your prospective lab what their acceptable lab precision limits are, and make sure they agree with the limits in your quality assurance project plan. Then, make sure you get results from lab replicates analyzed with your batch of samples, and calculate the precision of that analytical run.

Volunteers who analyze their own samples should replicate at least one sample for each parameter on each sampling day. Because volunteer programs do not analyze the same volume of samples as commercial labs, it is necessary to replicate a higher number of samples in order to evaluate analytical precision. Also, as most volunteer monitoring programs are aware, the quality of volunteer-generated data is frequently questioned. A higher number of replicate measurements allows for a better estimate of precision, which adds to the credibility of data collected by a volunteer program.

2. Lab check standards

Lab check standards are solutions of known concentrations that are analyzed as part of a lab's internal QC program. Ideally the check standards will be in the same concentration range as your samples. For example, if you expect your samples to range from 0 to 100 mg/L, you don't want the lab check standards to range from 100 to 1,000 mg/L. If the range of the check standard concentrations is outside the range of concentrations expected in your samples, you will calculate an estimate of lab accuracy that won't apply to your batch of samples. Worse, it is likely that the analytical instrumentation has not been calibrated correctly to analyze your samples.

3. Matrix spikes

Matrix spikes are lab splits with a known concentration of the parameter (usually nutrients or metals) added to one of the splits. The spiked sample is analyzed and the result compared to the result from the unadulterated sample. The amount of the spike that was "recovered" is reported as a percent and gives an estimate of bias due to calibration and interference effects. Bias is a measure of the difference between the result for a parameter and the true value. Bias can be due to error introduced from sample collection, instability of samples, interference effects, calibration of the analytical instrument, and contamination.

Ask the lab to provide you with results from matrix spikes run with your batch of samples. As with lab check standards, the concentration of the spiked sample should be in the same range of concentrations as the rest of your samples. For example, if your sample concentrations range from 0 to 100 mg/L, the spike concentration should not be 200 mg/L.

4. Lab blanks

For most parameters, labs routinely analyze blank samples. In addition to indicating whether the analytical method introduced contamination, results are used to calculate detection limits. Detection limits include estimates of detecting false positives (probability of detecting an analyte when it is not present) and false negatives (probability of not detecting an analyte when it is present). Volunteers who analyze their own samples should also analyze blanks.

Not all labs calculate detection limits the same way. Usually, though, the standard deviation of the results of several lab blanks is used in the calculation. Because there does not seem to be a standard method used to calculate detection limits, there are labs that claim low detection limits, but the "limit" would be much higher if a different calculation method was used. For your program, decide on a method for calculating detection limits, and ask the lab to provide you with the results of the blanks run with your batch of samples.

You will have to calculate whether your requirements for detection limits were met.

5. Audit samples

Audit samples are synthetic samples with known concentrations. They can be purchased, or they can be prepared by a QA officer or a volunteer monitoring program coordinator. Audit samples can be analyzed as part of a lab's routine QC runs, or they can be poured into a field sampling bottle so that the audit sample is "disguised" as a regular sample.

Preparing and analyzing audit samples may be a good idea if monitoring results may be used to settle an issue (especially any legal disputes), or if a large number of samples (more than 100) are collected and analyzed for each parameter, or if you have unusual or particularly stringent QA/QC requirements. If you decide to use audit samples, make sure the concentrations of the samples are in the range of your sample results. For example, don't submit an audit sample of 1.00 mg/L for total phosphorus if most of your water samples are expected to be around 0.050 mg/L.

For Washington State's lake monitoring program, two to three audit samples for total phosphorus and total nitrogen are disguised and sent to the lab during each survey. Because concentrations of total phosphorus are very low in Washington lakes, concentrations of the total phosphorus audit samples range from 7.5 µg/L to 150 µg/L. I have used results from audit samples (sent in "blind" disguised as lake samples) to convince a lab that there was a problem with their analytical method. Although the lab's internal quality control results were within their acceptable limits, the lab's QC requirements were based on analyzing effluent samples (with high phosphorus levels), as opposed to analyzing water samples collected from lakes and streams. My QC requirements were not met, so I had to throw out all the data from that survey.

Macroinvertebrate Monitoring

Moderator: **Geoff Dates,** River Watch Network
Presenters: **Geoff Dates; Dave Penrose,** North Carolina Department of Health and Natural Resources

Geoff Dates
River Watch Network

Dave Penrose
North Carolina Department of Health and Natural Resources

I. Introduction and overview

A. What are benthic macroinvertebrates?

We have two definitions—a biological one and a practical one:

- Biological: Aquatic animals without backbones that spend at least a part of their life cycle on the river bottom.
- Practical: Aquatic animals without backbones that will not pass through a 0.6-mm mesh.

Benthic macroinvertebrates include aquatic insects—such as mayflies, stoneflies, caddisflies, midges, and beetles—as well as crayfish, worms, clams, and snails. They inhabit all types of running waters from rushing mountain streams with rocky bottoms to sluggish, meandering rivers with sand and mud bottoms. These organisms are important indicators of the *biological integrity* or biological health of our rivers and streams.

Most macroinvertebrates go through a series of changes in form—from egg to adult—known as *metamorphosis.* The length of this cycle ranges from less than 2 weeks for some midges and mosquitoes to 4 – 5 years for some dobsonflies and dragonflies. Macroinvertebrates we collect from the river bottom are primarily in their larval form.

B. What role do they play in the stream ecosystem?

Benthic macroinvertebrates exist in a wide range of locations in the river:

- Shallow, fast-moving, rocky bottom areas known as *riffles.*
- Deeper, slower moving sandy and gravelly bottom areas known as *runs.*
- Deep, slow-moving muddy-bottom areas known as *pools.*

By far the most diverse community is found in the riffle areas. This is because riffles contain a variety of bottom materials that provide an abundance of surfaces and spaces for living and feeding. The faster current brings food, which is present in the water column, deposited on the bottom, and growing on the rocks.

Benthic macroinvertebrates are very important to the processing of food in the river ecosystem. They can be separated into four broad *functional feeding groups:*

Shredders feed on large pieces of organic matter such as leaves and other plant parts that fall into the river.

Collectors feed on small bits of organic matter (less than 1 mm in size) either by filtering them from the passing water (filtering collectors) or gathering them from the stream bottom (gathering collectors).

Scrapers (also called **grazers**) remove and feed on algae attached to rocks or log surfaces in the current.

Predators capture and feed on other animals in the river.

The feeding groups present tell us something about the nature of the food source in the stream. In forested headwaters areas, the food source is primarily large pieces of organic matter that fall into the rocky-bottomed stream from trees, shrubs, and other riparian vegetation. The *shredders* will make up a large percentage of the community. In the mid-reaches, riparian trees no longer shade the entire stream and light may penetrate to the bottom. The resulting plant growth on the rocks provides food for the *scrapers* and this group will be well represented. Also, finer organic material processed upstream will be in the water column and settled on the bottom providing food for the *filtering* and *gathering collectors.* Because the mid-reaches contain a diversity of food sources and bottom conditions, a diverse community is usually present. In larger rivers, the bottom is primarily soft and sandy or muddy. Food is primarily fine organic matter in the water column and on the bottom. The *filtering* and *gathering collectors* dominate.

The point is that the community changes naturally from source to mouth, and you must take these natural changes into account when you survey the macroinvertebrate community in a river. Otherwise, you may incorrectly attribute upstream-to-downstream changes to human impacts, rather than the natural progression.

C. Why are they used to monitor rivers?

Benthic macroinvertebrates are good indicators of the river's condition for several reasons:

1. They are a measure of the river's biological integrity.
2. They reflect the physical, chemical, and biological conditions in the stream.
3. They can't escape pollution; they integrate the effects of short-term pollution events and long-term water quality.
4. They are a critical part of the river's food web.
5. Some of them are very intolerant to pollution.
6. They are relatively easy to sample.

D. What can they tell us about the condition of the river?

The macroinvertebrate community can be used to compare conditions upstream to downstream, above and below pollution sources, and from season to season and year to year. It

can also be used to evaluate the biological responses to physical habitat changes (like dams or dredging).

Benthic macroinvertebrate surveys measure a number of characteristics of the macroinvertebrate community, each of which tells us something about the condition of the river:

Abundance: the number of organisms present. Nutrient- and food-enriched streams will usually have a greater abundance of benthic macroinvertebrates. Both toxicity and physical habitat degradation (silt or sand erosion) will usually decrease the abundance.

Richness: the number of different types of organisms present. This is a rough measure of the diversity of the macroinvertebrate community. Usually the greater the number of taxa, the healthier the stream. However, some pristine headwater streams may be naturally low in richness, due to a relative lack of food (quantity and different types) and generally lower abundance of organisms. In these areas, an increase in richness may indicate pollution from organic material (from failing septic systems, for example).

Composition: the types of organisms that make up the community. In general, the mayflies, stoneflies, and caddisflies should be well represented. As a group, stoneflies are the most sensitive to pollution from sewage and other organic material. They usually make up a relatively small percentage of the sample (5-10%) and are usually the first to disappear from the stream. If they are not present, stream quality may be moderately degraded. Mayflies contain many taxa that are sensitive to pollution. They usually make up a significant percent of the sample (20-40%) and are usually the next to disappear. If neither mayflies nor stoneflies are present, the stream is probably moderately to seriously degraded. Caddisflies contain many taxa that are sensitive to pollution, but also certain genera (within the family Hydropsychidae) which are tolerant to pollution. It is very rare to find a sample with no caddisflies—usually the Hydropsychid caddisflies will be present even in seriously degraded streams. If the sample is dominated (>50%) by worms or midges, the stream is probably seriously degraded.

Functional feeding groups: groups of organisms that share a common feeding strategy and food source. If all functional feeding groups are well represented this indicates a diversity of food sources. If collectors dominate, it may indicate an overload of organic material in the water column or settled on the river bottom.

Pollution tolerance: the tolerance of organisms to organic matter and nutrients. With increases in pollution from sources of organic material like sewage or animal manure, the types of organisms in the stream usually shift from intolerant taxa (like stoneflies) to tolerant taxa (like worms and midges).

II. How to design a benthic macroinvertebrate study

Designing a benthic macroinvertebrate study involves making a number of decisions about what, where, how, and when you'll monitor.

A. What questions are you trying to answer?

Decide what you want to know about the river. Your decisions about where, how, and when to monitor will depend on the questions you're asking. Examples of questions include the following:

- How does the river change from headwaters to mouth?
- Is there any difference in the river between developed and undeveloped river corridors?
- What is the impact of a wastewater treatment plant on the river?
- What is the impact of specific residential, commercial, or industrial developments on the river?

Depending on the question, you select one of two general types of macroinvertebrate studies:

1. The **river biological characterization study** is intended to characterize the macroinvertebrate communities in an entire watershed area in order to evaluate the changes in these communities within a river system. This type of study would answer the first and second questions listed above.

2. The **impact assessment study** evaluates the effect of a human alteration of the river (pollution discharge, dam, etc.) on the organisms living there. This type of survey is intended to identify those changes in the biological community that are due solely to the alteration. It would help answer the third and fourth questions listed above.

B. Where will you collect the samples?

Sampling locations for a **river characterization survey** should reflect the full range of conditions in a river system. Some of these include:

- streams and rivers of different orders (sizes) or with different drainage basin areas
- streams and rivers located at different altitudes
- streams and rivers located in areas of differing predominant land use (urban, agricultural, forested)
- streams and rivers receiving point source discharges (wastewater treatment facilities, storm drains)
- streams and rivers receiving nonpoint pollution (e.g., cities, towns, large residential developments, intensively logged areas, irrigated land areas, areas treated with pesticides, herbicides, or fertilizers, low-alkalinity streams sensitive to acid rain inputs)
- a reference site representing the best attainable macroinvertebrate habitat conditions in your area.

To select the reference site, consult with an experienced aquatic biologist who is familiar with the characteristics of the rivers in your area. The site need not be on your river, but should have similar habitat characteristics. Many state agencies have already identified these sites.

If you're carrying out an **impact assessment,** you'll need three sites:

1. **Reference or control site:** located immediately

upstream of any potential impact from the alteration.

2. **Impact site:** located immediately downstream of the alteration, at the point where the impact is completely integrated with the river water. The benthic macroinvertebrate community at this site is compared to the community at the reference site.
3. **Recovery site:** located downstream from the alteration, at a point where the river has at least partially recovered from the impact. The benthic macroinvertebrate community at this site is compared to the community at the reference site.

C. How will you collect and analyze the samples?

1. Habitat assessment

The habitat assessment measures a number of characteristics that are important to the benthic macroinvertebrate community. This assessment includes the *primary habitat characteristics* (those that have the greatest effect on the structure of the macroinvertebrate community), which are river bottom composition, percent embeddedness, and current velocity. It also includes *secondary habitat characteristics* such as channel alteration, sediment deposits in pools, riffles characteristics, channel flow status, condition of banks, bank vegetative protection, riparian vegetative zone width, overhead canopy, water appearance, water odor, water temperature, water depth, percent algal growth, and velocity/depth regimes.

2. Collecting macroinvertebrates

Nets are used to catch organisms which are dislodged from the river bottom immediately upstream. This technique is best suited for use in riffle habitats.

Advantages of nets: A net enables immediate collection of a sample, on short notice. The collection technique is relatively easy for trained volunteers to use. It also samples the river bottom directly and the organisms collected are those that are actually living there.

Disadvantages of nets: Nets are not useful in deep, muddy rivers. They may be difficult to use where the river bottom is embedded with sand or silt. Sampling technique may differ among samplers, introducing an error into the results.

Artificial substrates are devices which are placed on the river bottom, or suspended in the water column, and provide a place for the macroinvertebrates to colonize over a period of time—usually 3 – 5 weeks. The devices are then retrieved. Check with your state's aquatic biologist to see what type is recommended. Two types of artificial substrates are commonly used: *Multi-plate samplers* consist of tiles stacked with spacers on an aluminum turnbuckle. *Rock baskets* consist of a wire mesh basket filled with similar-sized rocks (4 to 12 cm in diameter) collected from an exposed area along the stream.

Advantages of artificial substrates: The use of artificial substrates helps eliminate variations in sampling techniques and standardizes the type and area of macroinvertebrate habitat between sites. This is particularly important in impact assessment surveys, where upstream and downstream sites will be compared. Artificial substrates also enable sample collection in areas that do not lend themselves to the use of nets—for example, deep rivers or sandy or silty bottoms.

Disadvantages of artificial substrates: Substrates can be washed away in high flows, lost, or stolen. They also require at least a month's lead time to allow the organisms time to colonize the substrate. They may not invite colonization from burrowing organisms, such as worms. Therefore, the sample may not include all the organisms that are actually living at the site. Further,

Table 1: Field vs. Lab Processing

FIELD PROCESSING

Advantages	Disadvantages
Volunteers gain quick feedback on conditions	Some organisms difficult to ID in field
Techniques relatively simple	Limited taxonomic information
Organisms not killed	Limited sensitivity
Work completed on day of collection	Quality assurance is difficult
Behavior of live critters helps ID	Field conditions can be difficult

LAB PROCESSING

Advantages	Disadvantages
ID easier using high magnification	Work is time-consuming and intensive
Organisms can be ID'ed to family and beyond	Rigorous training required
More sensitive; can detect subtle impacts	Expensive equipment and lab equipment
Quality assurance relatively simple	Involvement of aquatic biologist needed

they represent an ideal physical habitat, which may not really exist at the site. Therefore, the organisms that colonize the substrate might not be able to live at the site, due to heavy sedimentation, for example.

3. Field or lab processing of samples?
Once the samples are collected, they may be processed either in the field or in the lab.

Field processing involves picking a subsample and identifying the organisms to some taxonomic level, usually order and some families.

Lab processing involves preserving the sample or subsample and bringing it to a lab for later identification, usually to family and some genera or species.

Table 1 shows some advantages and disadvantages of each method.

4. Identification
There are two main considerations in deciding which level of taxonomic identification to undertake: (1) the identification skills of you and your volunteers, and (2) the sensitivity required of the study.

Identification to order can be fairly easily accomplished by a trained nonbiologist. Family level taxonomy involves knowledge of some fairly subtle differences in body characteristics, and requires the availability of an aquatic biologist or entomologist to verify the identification.

The sensitivity of the study refers to its ability to detect changes in the community from site to site. Sometimes these changes are subtle. For example, identification to order might show a predominance of mayflies and caddisflies. Identification to family might show that they are all from pollution-tolerant families. Family level identification also allows the identification of *functional feeding groups*.

D. When and how frequently will you collect samples?
There are a number of considerations in determining time of year to collect the samples:

- Avoid periods of heavy emergence: This can affect your upstream-to-downstream comparisons. Spring and early summer are heavy emergence periods in the Northeast.
- Do you want best- or worst-case conditions? Best-case conditions are usually in the spring, worst-case in late summer and early fall.
- Consider the life cycles and size of the organisms. Identification of immature larvae can be very difficult. As the organisms grow, their body characteristics become more pronounced. Organisms are usually largest in the spring, before they emerge.
- When does your state agency sample? If you expect them to use your data, you should sample when they do.
- Avoid high flows. High, fast water is dangerous and makes it difficult to do quality collection.

Ideally, macroinvertebrate samples should be collected four times a year (once per season). If this is impractical, we recommend at least one sampling in the early fall. In the fall, the community is more stable—fewer organisms emerge from the water in their adult forms. In addition, the macroinvertebrate community in the fall may represent a "worst-case scenario" because it will reflect the effects of summer high temperatures and low flows.

If possible, an early spring sampling should also be done. This is useful to evaluate how the community changes over the summer.

E. What quality assurance procedures will you use?
We recommend the following quality assurance steps:

Replicate samples: Collecting two or three replicate samples at each site helps assure the representativeness of the samples.

Duplicate collection: Another team or, better yet, a professional aquatic biologist collects samples at the same site, at the same time (within a day) as the volunteer team.

Sample preservation: Samples are preserved in 90 percent ethyl alcohol, archived in labeled vials, and can be reprocessed at any time.

Verification by a professional: Identification of organisms by volunteers is checked by an aquatic biologist.

Habitat assessment by the same people: The same people should carry out the habitat assessment at all the sampling sites.

III. How will you manage and interpret the results?

After you've identified the critters, you've got numbers of organisms associated with each taxonomic rank (order or family). These numbers can be summarized using the following data analysis techniques known as metrics. These metrics describe the benthic macroinvertebrate samples collected in terms of abundance, diversity, pollution tolerance, composition, how they compare with each other, and how they compare with a "model community."

A. Density (abundance)

Organism Density per Sample: An estimate of the total number of individuals in the sample.

B. Richness (diversity)

EPT Family Richness: The number of mayfly (E), stonefly (P), and caddisfly (T) families present. This is an estimate if organisms are identified only to order.

Total Taxa Family Richness: The number of macroinvertebrate families present. This is an estimate if organisms are identified only to order.

C. Pollution tolerance

Modified Family Biotic Index: This analysis, developed by Hilsenhoff, assigns each family a pollution tolerance value from 0 to 10, with 0 being intolerant and 10 being the most tolerant. Tolerance values should be adjusted for different ecoregions.

D. Community composition

Functional feeding group analyses: The percent composition of shredders, predators, gathering collectors, filtering collectors, and scrapers from a site. These numbers can also be used to calculate ratios—for example, scrapers to filtering collectors.

% dominance: The percentage of the sample made up of the dominant order, family, etc.

% community compositions (major groups, families): The percent of the sample in selected major groups or families.

E. Community comparisons

Pinkham and Pearson Community Similarity Index: This shows the degree of similarity between two sites, typically a site upstream of a stream alteration and one downstream of that alteration.

% Model Affinity: This is a measure of the similarity of the sample to a model "non-impacted" community based on the Percent Composition of Selected Major Groups. It is from the NY State Department of Environmental Conservation and can be adjusted by your state's aquatic biologist.

IV. What methods are out there and how can you choose one that's right for you?

There are three basic approaches to volunteer monitoring using benthic macroinvertebrates:

Stream Habitat Walk: Identification and assessment of stream habitat based on visual observation of habitat characteristics, benthic macroinvertebrates, fish, plants, and other attributes of the stream. Some measurements of stream characteristics are involved.

Streamside Bioassessment: The Stream Habitat Walk plus collecting benthic macroinvertebrates and identifying orders and some families in the field using standardized protocols. A stream quality index is calculated based on estimating abundance of organisms in three pollution sensitivity groups.

Intensive Stream Bioassessment: Collecting benthic macroinvertebrates, preserving the sample or a subsample, and identifying families in a lab. Identified organisms are archived for later verification. Data are analyzed using the metrics discussed above.

In general, these three approaches represent a successive increase in sensitivity and complexity, as well as in the time, expense and skill required. All three are useful for increasing public awareness and for screening to identify problems. The intensive stream bioassessment can provide more detailed and specific information about the severity of impacts and the effects of improvement actions. Picking the method that's right for you involves assessing your program goals, data quality objectives, human and financial resources, and level of expertise.

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Building Partnerships with Universities

Moderator: **Paul Godfrey,** Massachusetts Water Watch Partnership
Presenters: **Paul Godfrey; Bill Davies,** Auburn University Dept. of Fisheries; **Meg Kerr,** University of Rhode Island Coastal Resources Center; **Gail Whitney,** Saturday Academy of Oregon Graduate Institute of Science and Technology

Introduction

Paul Godfrey

There are many reasons why citizen monitoring programs would want to interact with universities. These might include the following:

- Access to student help
- Technical advice (e.g., for project design, data interpretation, taxonomic identification)
- Use of specialized equipment
- Laboratory analysis
- Database management
- Access to existing data
- Library facilities

The question is, How do you make the appropriate and successful university or college contact?

Finding the university partner

Suffice it to say that no university or college to my knowledge has an "Office of Citizen Monitoring Project Assistance" waiting for you to call. It's up to you to identify and target your potential partners. To do this, it's essential for you to recognize the reward systems of universities and colleges so that you may plan a strategy consistent with that system.

We probably all recognize that universities and colleges usually cite their mission as teaching, research, and public service. But on this basic mission tripod, not all legs are the same length. For example:

Community colleges and four-year undergraduate colleges place a heavy emphasis on teaching. Research is a low priority. Community colleges might be an excellent place to seek student help, particularly since many of the students may stay in the community after graduation and continue working with you. You might also gain access to equipment used in labs. However, sophisticated equipment is unlikely so don't expect special lab analyses or quality control help. If a faculty member helps, it will be on his or her own already limited time.

Colleges and universities with graduate programs exemplify a complete shift in priorities and rewards. Research becomes the principal focus, with the attendant need to get grants, publish results, and become respected among your peers. Public service always trails. The faculty may be interested in your project if there is a research angle as well as a student training opportunity. Lab and computer facilities will be present. Expertise is usually top-notch. However, the absolute need to get grants, produce publications, and derive part of their own salary can create a strong impetus for faculty not to "waste their time" on efforts that do not contribute in one of those three areas.

We also need to distinguish between public and private universities. Public universities are based on the land grant principle. Consequently, we see at those institutions outreach programs like Cooperative Extension, 4-H, Water Resources Research Centers, and many others that generally do not exist at private institutions. Therefore, the reward system at public universities is more likely to reward public service and outreach than at private universities.

On any campus, there will be strong differences between departments in how they view public outreach. The classic agricultural departments at public universities view this as a major role, but they may have a very restricted idea of who their clients are. Engineering departments are accustomed to outside consulting—for a fee—and actively discourage pro bono work.

And finally, there will be strong differences between faculty. Most notable will be the difference between untenured faculty and tenured faculty. Untenured faculty must measure up to rigorous standards of research and publication with good teaching or face termination after five or so years. Consequently, few young faculty can afford the risk that working with citizen monitoring entails. Tenured faculty are much freer to participate.

At public universities, the best place to start searching for contacts may be with the Cooperative Extension and Water Resources Institute offices. These folks are usually very knowledgeable about faculty interests. If the university has a news bureau, they often maintain up-to-date files on faculty interests. Failing these, I would request a university catalog. This will let you narrow your focus to those who specialize in your area of interest. A departmental head secretary can also be helpful.

Convincing the university partner

You should now consider what your program has to offer and what your university partner will be looking for. That is, what kind of "selling job" will you have to do to convince some part of a university to assist you?

Our panel will look at this question from the perspective of both the university and the citizen monitoring project.

Bill Davies
Auburn University Department of Fisheries

Cooperative Extension Service Involvement

The Cooperative Extension Service was founded to be an educational agency by the Smith-Lever Act of 1914. The intent was for the Service to work between the U.S. Department of Agriculture and the land grant universities, diffusing among the people of the United States useful and practical information relating to agriculture and home economics.

Clearly the interests of farmers, the public, and agriculture-related business do not always coincide. As a result, it is difficult, at times, for citizen monitoring groups to develop cooperative agreements with Colleges of Agriculture, and particularly with Cooperative Extension Service agents working at the county level. The availability of local funding is important in sustaining agent activities, and is influenced to some extent by large landowners in the county. Agents are often reluctant to provide support to groups that have not traditionally backed their programs. Often monitoring groups are formed because they disagree with, or are offended by, current land use practices. County agents are caught between conflicting interests and often choose to support those that have been providing support.

For citizen monitoring groups to work effectively with county agents, they need to be aware of and eventually overcome long-standing traditions. There is usually strong career and institutional inertia that must be overcome. Agents must meet certain expectations set at the local, state, and federal level. In some states, expectations for agents have been recently revised. For example, in Alabama, their role has been expanded to include:

1. Regain agricultural/forestry profitability
2. Develop, conserve, and manage natural resources
3. Enhance family and individual well-being
4. Develop human resources
5. Revitalize rural Alabama

This list might not relate to the concerns of some monitoring groups, for whom upgrading water quality standards or increasing biodiversity of aquatic organisms in streams are goals.

There are communication barriers that affect the types of questions asked. For example, instead of asking, How can we reduce phosphates in streams? a citizen monitoring group might ask, Why is phosphate high to begin with? The latter would have social/cultural implications not necessarily implied by the former.

There can be differences in philosophy. When an ecological perspective is assumed, rather than the reductionist view often associated with traditional science, small but cumulative effects may be documented by determining long-term trends. The value of an ecological perspective and associated trend analysis will usually have to be justified to those used to a more traditional view of science.

There is a tradition that for nature to have value, it must be subdued and conquered. Writing early in the 17th century, Frances Bacon stated, "Bid her [nature] to your service, and make her your slave." We have phrases in common use today such as "battling" weeds and "eradicating" pests. Citizen monitors often have a different philosophy, one in which the stability, integrity, and beauty of land-waterscapes should include "weeds" and "pests."

And finally, there is the problem of objectivity. Traditional science means only trusting carefully controlled, measurable results. Monitoring data does not necessarily fall into this category, and is therefore viewed as having less or no value. Monitors must strive to follow quality control procedures and be systematic in data collection.

The Cooperative Extension Service is an agency in transition. Rooted in the traditions of the past, it is evolving from merely extending information to becoming agents of change. Citizen monitoring groups and the Cooperative Extension Service can work together to find common ground.

Meg Kerr
Coastal Resources Center, University of Rhode Island

Involving University Students

For the last few years I've been working with college students as volunteers and interns with the River Rescue program. This has been a bit of eye-opening experience. Students are not part of the 9-to-5 world, and there are several points you need to consider in working with them.

Although students do have coursework and knowledge that can be very useful to your program, they rarely have practical experience. Getting them up to speed may take some time and effort. Consider whether you can get them trained well enough in the relatively short time available to realize the benefits of the training effort before their involvement ends. One solution is to develop contracts with students. The contract should include the student's beginning and ending date (usually at least one academic year) and define their responsibilities as well as what you will provide.

Remember also that students' priorities may not match yours. For example, you may have a conference coming up when they have exams. I can guarantee you that your conference won't be their top priority! Also, students are accustomed to having long vacations in the winter, spring, and summer. They may not want to give up their vacations to suit your needs; or the school may require that they leave their dorm room during vacations, and they may have no place to live unless they go home.

Transportation and money can also present problems. Students are often living on a shoestring. They may not have cars, or if they have a car, they may not have money for gas.

Students cannot be expected to pay upfront for supplies, conferences, and transportation, even if they will eventually be reimbursed.

How to attract students

Students are generally attracted to working with a volunteer monitoring project for one or more of the following three basic reasons:

1. They would like to get job experience.
2. They are doing an internship for course credit.
3. They are being paid.

Let's look at some advantages and disadvantages of each of these reasons, from the point of view of both the citizen monitoring group and the university.

1. **Job experience.** College students, especially seniors, may be willing to volunteer for your organization simply to gain experience in working with a nonprofit organization and doing scientific work.

An advantage from your point of view is that students who are interested in gaining experience are often highly motivated and will do a good job if they see that the work will assist their careers. The flip side, of course, is that if they decide this kind of work is not for them, their motivation will become very low. It is important to assess these students' interests and assign them to tasks that are compatible with their future plans. Remember that the arrangement is a two-way partnership. If they need to maximize job contacts, try to introduce them to individuals and agencies that will be helpful to them.

Another advantage to you is that you design the project (which might not be the case if they were working for course credit). On the other hand, you won't have the faculty contact you would have if they were working for credit. Another disadvantage is that you have limited control over their hours, since they are just volunteering their time.

From the university's point of view, having students volunteer with your organization is desirable because it helps with future student job placement and it can make coursework more relevant, making students more likely to stay in school. A possible disadvantage is that the students' work with your project may distract them from their schoolwork.

2. **Course credit.** Students working for credit are often highly motivated because a final product will result, for which they will be graded. Another potential advantage to your organization is that you have the opportunity to help design a highly technical project for them. A danger, though, is that while the student's project may be an interesting research question, it may not be of much practical benefit to your organization. Also bear in mind that the project must have a defined beginning and end, and that you will have to coordinate with faculty (the latter can be either an advantage or a disadvantage to you, depending on the faculty).

From the university's point of view, having students work with your program for course credit is advantageous because it provides students and faculty with the opportunity to do applied research and it allows the university to expand its course offerings at no expense. A drawback is that the kinds of projects you offer may not be scientifically valid enough for university research.

3. **Wages.** When you hire students for wages, you have more control in assigning their duties and work hours. You also have the potential to hire students who possess specific skills that you need—for example, knowledge of GIS (geographic information systems) or macroinvertebrate identification. The down side is that these students will most likely leave when their degree is complete. So you need to decide whether it would be more cost-effective to hire a regular employee, who would probably have more experience and stay longer.

From the university's point of view, advantages are that your organization is providing students with financial support and practical job experience.

Paul Godfrey

Massachusetts Water Watch Partnership

Water Resources Research Institute Involvement

A number of citizen monitoring projects have been initiated, funded, supported, or encouraged by Water Resources Research Institutes (WRRIs). Immediately coming to mind are the New Hampshire Lakes Lay Monitoring Program, the Acid Rain Monitoring Project in Massachusetts, and Project WET in Montana. I know that directors of WRRIs in Maine, New Hampshire, Connecticut, and Idaho have been actively involved. It's worth knowing a bit about how and why WRRIs operate.

What are WRRIs?

WRRIs were created in 1965 by the Water Resource Research Act. The program is currently administered by the U.S. Geological Survey. There are 54 institutes—one at the land grant university in each state and one each in Guam, the Virgin Islands, Puerto Rico, and Washington, DC. They all have the same three goals: to foster water resources research responsive to state, regional, and national needs; to train future water resources professionals; and to conduct a credible information transfer program to bring the research results to the community. However, each institute finds a different balance between these goals.

Institute programs are very flexible. Very little falls outside the realm of possibility. The major constraint is funding. Institutes are currently receiving $100,000 in federal funds to run their operations. These must be matched by $200,000 in nonfederal funds—usually contributed faculty time and overhead. Many institutes also have state appropriations and/or contracts with other federal, state, or private sources.

The federal funds must not be used strictly for monitoring—there must be either a research or information transfer aspect. So measuring the flow in a stream to produce a table of flow data would not be acceptable, but measuring the flow in a stream to evaluate the effect of land use, topography, etc. on minimum flow would be perfectly acceptable.

Support available from WRRIs

Institutes typically put approximately 60 percent of their funds into research, most going for student support. They are required to submit an annual proposal for funding. There is little opportunity for an institute to provide support from these funds except within this annual schedule.

Institutes solicit proposals from academic faculty throughout their state, not just those at the host university. This may be the single most important difference between WRRIs and all other university institutes, centers, and programs. The funds cannot go to nonacademic groups unless someone there has some kind of academic affiliation such as an adjunct position. So the interested citizen monitoring program must find a kindred faculty member somewhere in the state to submit the proposal. The proposal will be in competition with other research proposals, so the research aspect must be strong.

An underutilized part of the program is the information transfer aspect. Most institutes rarely receive information transfer proposals. However, this is a very valid part of the program which would not be hard for a citizen monitoring program to use.

"Selling points"

Whether you are submitting a research or information-transfer proposal, there are several things to keep in mind. Institutes are always looking for ways to enhance their role in coordinating the water resources community, meeting state water resources needs, enhancing their and their universities' constituency, and garnering a little political attention in the statehouse, Congress, and the media. Citizen monitoring projects offer more of this than almost any other comparable expenditure. I think in large part as a result of the success of the Acid Rain Monitoring Project, most directors are very aware of the potential benefits offered by grassroots citizen monitoring programs.

Other advantages for a WRRI are: the development of a potentially useful database for research and teaching, opportunities for student training, expanded connection with agency data users, and the chance of leveraging a volunteer monitoring project into complementary research projects.

The difficulties for the institute come from having to deal with a diverse constituency that includes more lay people than many academics normally deal with professionally, the challenge of using the political and media opportunities effectively, and the possible perception by campus colleagues and administration that this is not what institutes really ought to be doing—i.e., the same uphill battle that most faculty face with any kind of public service effort. I believe that, in most cases, you will find WRRIs less hidebound than other comparable institutions.

If the director is not yet a kindred spirit (and he or she probably isn't), you should plan on taking time before the proposal deadline to sell your idea. Include the selling points mentioned above, and demonstrate to the director that you have a well-conceived design, top-notch quality control, plans for information delivery, and ideas on how the institute can benefit.

Institute directors are a diverse group. When I became a director 14 years ago, I was one of very few who were not engineers; now engineers are a distinct minority. Directors' backgrounds range from solid state physics to law, economics, and planning.

Pros and cons for the monitoring project

The advantages to your project of an institute partnership will, I believe, vastly outweigh the effort required to involve an institute. You will have easier access to the technical expertise at most colleges and universities in your state. You will have increased credibility for your project because scientists will be involved as advisors. You may have access to lab and computer facilities and equipment that are not readily available elsewhere. You will have a potential pool of willing students.

If you are seeking funding, you should expect that an institute will provide it for only a few years. Other means of support should be developed during your brief period of institute support.

You may not need or be able to get funding from an institute but may still be able to obtain the other benefits. Even having an institute staff in an advisory role may pay enormous benefits in added credibility. Such services are not free, so your fund-raising should include covering some of the expenses of the institute.

Your disadvantages will be in having to accept considerably more scientific rigor in your project, having to deal with a sometimes monolithic administration that likes to extract overhead costs as often as possible, having to deal with an institute director who is probably juggling a dozen things at once, and having to tone down your advocacy positions and statements or else make it clear that the university and institute do not necessarily endorse your views.

For example, the Massachusetts WRRC is providing technical expertise, coordination, data management, and training for a number of lake and river associations in Massachusetts. We tell them all that we do not do advocacy. If they want to bring a farmer before the Board of Health, that is their role—not ours. We will not do it for them or even go with them. We will, however, assist them in interpreting their results and developing a presentation so that their advocacy is well founded and well presented.

Gail Whitney

Saturday Academy, Oregon Graduate Institute of Science and Technology

University Support of Pre-College Monitoring Activities

Saturday Academy is a pre-college program designed to place middle and high school students, and their teachers, into direct contact with community expertise and resources. Based at Oregon Graduate Institute of Science and Technology (OGI), Saturday Academy interacts with the graduate program in Environmental Sciences and Engineering at OGI, as well as graduate and undergraduate programs at the other public and private colleges and universities in the area. This ability to cut across institutional territorial lines allows Saturday Academy to optimize the support available for volunteers to develop skills and knowledge in monitoring urban natural areas, rivers, and wetlands.

As mentioned in the other presentations, there are pros and cons involved in interacting with any institution. Our goal is to engage students in "citizen science"—in feeling that they can do good science and make meaningful contributions to their world. Since this is education, it must be done on a shoestring, and thus we must rely on the kindness of volunteers, especially those who relate well to pre-college students. Undergraduate and graduate students are made to order for this; they get to be role models, unlike their usual rank in the academic food chain.

Saturday Academy has two NSF-funded projects that engage middle and high school teachers and their students in monitoring activities: the Student Watershed Research Project (SWRP) and the Green City Data Project. Both involve the collaboration of higher education, natural resource agencies, and informal science providers, such as Audubon, in intensive training in the knowledge and technique of water quality monitoring and natural history inventory. After its second year, SWRP is turning out classrooms of students who can produce reliable water quality data (by agency standards) for a variety of tests. Green City Data teams have been producing maps and reports for the Portland area's Metro Greenspaces Project. In both cases, college and university faculty and student participation in training and quality control have been essential.

While the faculty have received small stipends, student participation has been motivated in part through award of undergraduate or graduate credit. In Green City Data, a graduate cartography seminar was responsible for training and supervising 18 middle and high school teams in the field mapping of 21 urban natural sites being considered for acquisition or restoration.

Faculty have been expert instructors at training workshops, advisors on curriculum development, recruiters of "student-power," quality control monitors, and campus hosts for bright, motivated pre-college students, as well as being resource people and colleagues for high school and middle school teachers.

Another crucial role of the university is champion of good science. Students learn the care and effort involved in collecting valid information that is as free from bias or vested interest as possible. From this base they are encouraged to evaluate data, examine issues, report their findings, and even advocate a particular position—but from observation and analysis.

These interactions are of sufficient value that I predict they will endure, whatever the fluctuations in all the funding sources that can vary in so complex a set of relationships, because students want to and do learn good science in service of the world they are inheriting. The university is the appropriate partner for its "big picture" perspective, the science it can model, and the human and other resources it can contribute to this enterprise.

Increasing Communication Among Volunteer Programs

Moderator: **Rita Haberman,** River Network
Panelists: **Andy Alm,** GREEN/Econet; **Jack Byrne,** River Watch Network; **Ken Cooke,** Kentucky Water Watch;**Rita Haberman**

Andy Alm
Global Rivers Environmental Education Network (GREEN); EcoNet

Computer Networks

Does the net work?

Networking itself isn't an answer. The net only works if it catches fish, and the fish in this case are effective strategies for improving water quality and aquatic resources (including habitat for real fish). The net works if it empowers all involved with citizen monitoring efforts to be more effective in improving water quality and empowers local communities to be active participants in policy making.

If communication gives us more information, it is useful . . . IF the information itself is useful. Too much information is not a good thing. Likewise, contact with a broader network of people doing volunteer monitoring can provide inspiration, new ideas, teamwork to accomplish tasks too big for any one group or individual, and a sense of community—even a global community—that provides moral support and encouragement. But too much interaction, like too much of anything no matter how good, is not a good thing. We can find ourselves swamped with reading and writing, ear glued to the telephone, eyes glazed from staring too long at a computer screen.

What we need to share

Citizen monitors need to share the data they collect—with their communities, with responsible agencies and research institutions, and with each other. We need to share not only data, but our human experiences, our successes and failures, and the social contexts that affect our environments. We need to understand that there are many paths to the goal of living as a human race within the planet's ecology, and we need to learn to understand, in our hearts as well as in our minds, that in the diversity of our efforts is great strength and hope.

How to communicate

We need to follow a couple of rules in approaching communication. First, no single communication medium is better than the others, and each is more effective when integrated with the others. Second, the most potent communication is that which empowers all participants as active contributors and learners rather than as passive receivers. Thus communication which engenders critical thinking, encourages imagination, and stimulates action is more powerful than that which simply informs or entertains. A group discussion is more potent than a lecture.

Computer networks, global dialogs

A global dialog can help remove the social and structural barriers to progress, and is essential if we are to resolve problems that are global in their magnitude, such as the degradation and destruction of the earth's aquatic ecosystems. It is the vision of globally empowering, interactive communications—via computer networks—that has caused the Internet to grow exponentially, with now more than 2 million participants around the planet.

Direct communication between groups and individuals via computer networks can reduce the bottlenecks and filters that limit information flow. Editors, those much beloved and maligned gatekeepers of (and sometimes barriers to) mass communications, will become in this new vision the facilitators, distilling the river of information that they touch, but not muddying it or diverting or impeding its flow. More and more of us will be editors, for better or worse.

Computer networks and citizen monitoring

How can computer networks benefit citizen monitoring efforts? They can open new possibilities for collaboration, for access to human and information resources, for sharing human experience across what once were rigid barriers of gender, culture, geography, and wealth. These networks must not be superhighways accessible to some and bypassing others; they need to be more like the clouds, the rain, the rivers, and the seas: moving and recirculating information, allowing all to drink and to ride the currents, then moving on.

Computer bulletin boards, such as EPA's NPS Bulletin Board, and computer systems accessible via the global Internet, such as EcoNet, EcoGopher at the University of Virginia, and the EELink Gopher at the University of Michigan, provide forums for information-sharing and community-building among volunteer monitoring groups. GREEN is an example of how these networks can be used to cross-link a diverse array of groups that share the goal of community watershed education and stewardship.

There are barriers, rocks in the stream, that limit adoption of this new medium. There are too few vessels to dip into it or float upon it. There are vast deserts where it does not flow, places where its cost is too dear or its quality unsuitable. There are many, many who have not learned to swim or are afraid to try. But its waters are spreading, and more and more, they will touch us all.

Sample it. Test it. Share your results.

Jack Byrne
River Watch Network

Creating Dialog

One of the barriers to communication is that often we don't know what is going on in the other person's mind. For example, River Watch Network recently spent two weeks in Hungary working on a pilot project on the Danube River. The Hungarians we were working with were very fluent in English. Nevertheless, after two or three days we realized that a lot of the things that we thought we had agreed on beforehand were very different from the things they were now talking about doing. Even though we were speaking the same language, the meanings we intended to give to words were very different from what they were understanding. So we got into this convention of saying, "Now you tell me what I just said." We did that the whole time we were there.

It's important to be really clear about what you're saying, and not to be shy about asking people, "What do you mean by that?" or saying "I don't understand."

Dialog vs. discussion

A goal for this workshop is to find ways to create and sustain dialog among people in this movement. Here's a definition of dialog from a book called *The Fifth Discipline: The Art and Practice of the Learning Organization.*: "Dialog is a free flow of meaning between people in the sense of a stream flowing between two banks." That's different from discussion. Discussion is more like a ping-pong game—you're throwing your views back and forth and the goal is to try to get the other person to accept your view. We do a lot of discussion and we don't do a lot of dialog.

We've got 300 people here at the conference; we've got 15,000 people who read *The Volunteer Monitor;* and from the survey done for the most recent national volunteer monitoring directory, a good guess would be about 250,000 people involved in the volunteer monitoring movement. That's a lot of potential either for a lot of noise, or for some real collective wisdom. We want to reduce the noise.

Thinking vs. thoughts

In order to have dialog, I think we have to see the difference between thinking as a process, and the results of that process, which are thoughts. I'd like to end with another quote from *The Fifth Discipline:* "Through dialog, people begin to observe the difference between thinking as an ongoing process distinct from thoughts, the result of that process. Through dialog, people can help each other become aware of the incoherence in each other's thoughts, and in this way collective thought becomes more and more coherent."

Group Discussion

The rest of the"Increasing Communication" workshop was conducted as an interactive group discussion of four questions. Discussion was focused specifically on increasing communication *among volunteer monitoring programs*, as opposed to increasing communication between volunteer programs and other entities (the public, goverment, the media, etc.). The ideas and recommendations that came out of the session are summarized below.

1. WHY do we need to increase communication among volunteer programs?

- To learn from each other's experience and mistakes
- To make connections and learn about new opportunities
- To be inspired by each other; to share a larger vision
- To organize watershed-wide monitoring efforts and planning
- To respond to issues in a timely fashion
- To increase volunteer monitoring's credibility by speaking with a unified voice
- To be able to send a coordinated message to government
- To bring more people into the movement

2. WHAT do we need to communicate with each other about?

- Our success stories—measurable, tangible victories and results
- Our failures
- Our data
- Legislative initiatives, especially the Clean Water Act
- Monitoring methods
- Volunteer program management techniques
- Outreach techniques
- Ideas for fundraising
- Volunteer monitoring's "agenda"
- Enforcement strategies
- Model programs

3. What avenues and means of communication are available to us?

- Various EPA-supported resources
  - *The Volunteer Monitor* newsletter
  - National directory
  - Conferences and conference proceedings
  - Guidance documents
  - Electronic bulletin board (NPS-BBS)
- Partnerships and coalitions
- Committees and advisory groups
- Computer networking; data-sharing software
- Telephone; conference calls
- Videos
- Regional meetings
- Individual programs' newsletters

4. How can we improve our communication with each other?

- Publish regional or watershed-wide newsletters

- Establish a National Monitoring Day
  - one-day sampling across nation (Secchi Disk Dip-in?)
- Publish *The Volunteer Monitor* more frequently
- Use interactive, visual computer communication
- Establish community electronic bulletin boards
- Exchange individual program newsletters
- Share mailing lists (with caution!)
- Establish a volunteer monitoring referral service/ information clearinghouse
- Avoid information overload

Fundraising, Part One: Developing a Fundraising Plan

Moderator: **Susan Handley,** U.S. EPA Region 10
Presenters: **Elizabeth Heath,** Morgan Heath Consulting; **Jacqueline Jackson,** Oregon Community Foundation Communications Coordinator

Elizabeth M. Heath

Morgan Heath Consulting

There are four keys to fund development:

1. **Plan**
2. **Just tell the story**
3. **Personalize**
4. **Cultivate**

But before we get to those, it will be helpful to cover some definitions and common fund development practices.

Fund development vs. fundraising

You may have already noticed that I say "fund development," not "fundraising." I can be, and have been, accused of semantic hair-splitting, but I believe the difference is critical to our mind-set about generating support.

When we speak of fundraising, we are talking about activities that raise money. Of course. Isn't that what we're about? Yes, but it is much more than that. Fund development is the practice of articulating your cause, communicating that information to prospective donors, linking your cause with their priorities, asking for their contribution, thanking them, and keeping them informed about what you're doing.

The difference is developing relationships with people, the outcome of which is increased financial support for your cause, often year after year. In fundraising, you're just doing something that brings in money—there's no commitment on the part of those who give you their money, and there's no assurance that those same people will give you money again.

Another difference is that of timing. Depending on what you are doing, fundraising might be the right strategy for you. While fundraising activities are time- and labor-intensive, they can be put together in a relatively short period of time. Fund development is for the long-term. It may cost you everything you receive in contributions to bring in your donors the first time on a cause-related basis, but over the years you can reap the benefits of their increased support for what you are doing.

Donor pyramid

Another fundamental concept is often called the "Donor Pyramid." You begin with all of your prospects (and you should remember that a 2 percent response to an appeal is considered standard) and then move up to those you have interested enough for them to make a contribution. When you go back to these people for a second gift (usually a year later), you have them hooked. Then your job is to thank and communicate with them—to keep them part of your organization. The upper categories include donors who make major gifts, who contribute significantly to building and equipment projects (capital campaigns) and who make what are called "planned" gifts (bequests, trusts, etc.).

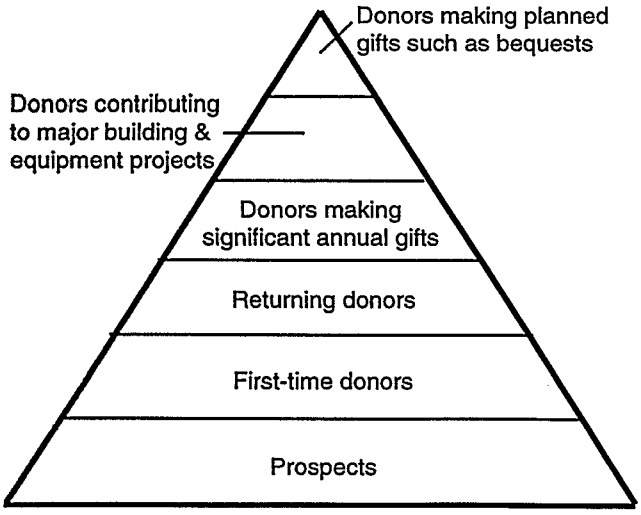
Corporations and foundations

What I have presented so far has been focused on generating support from individuals. (After all, most private philanthropic support comes from individuals.) However, almost all of the above applies to corporations and foundations as well. You must start by doing your research and targeting:

- Which grantmakers have priorities that match your cause?
- Which give in your geographic area?
- How do they want their proposals submitted, and when?
- How much is an appropriate amount to request?
- Who are the decision makers and do any of your volunteer leaders have any connections with any of them?

For example, in Tacoma two local foundations differ greatly in how they want to be approached. For one, it is important to speak with their program officer first and discuss your project. If your project falls within their guidelines, the program officer will then help you refine your project, and the result will be a formal inquiry letter which will be submitted to the foundation's board. The second foundation publishes

The Donor Pyramid



the information that it wants you to include in your request letter, as well as the timing and address for submittal. After you submit your request, you hear nothing for some time, until their board takes action. Calling to talk with the program officer is not acceptable.

Corporations are different from foundations in that they are usually much more approachable. As in any other fund development activity, peer-to-peer contact is vitally important. Again, advance research is essential, especially in how to approach the decision maker and how well your request will match the corporation's priorities for giving.

Another example: In the great bank shuffle of the past few years, one of the new banks that came to town did so with a strong sense of corporate responsibility, which they backed up with major contributions. Naturally it didn't take very long for folks to figure that out, and when they did, the bank was besieged with requests.

The organization I was with figured that what the bank staff probably wanted more than anything was planning and predictability. So when we submitted our proposal it included this promise: If the bank would sponsor an event at the $10,000 level, we would not ask them to support anything else for the rest of the year. It worked, and both they and we won. They focused their contribution for maximum visibility to them, and got the predictability of knowing that they didn't have to make a number of decisions throughout the year on smaller requests. We won because their contribution to our organization was increased by 35 percent and we had our major sponsor for next year's auction. It's the old marketing adage: Know Your Customer!

The four keys

Now let's get back to the four keys to fund development that I mentioned at the beginning of this presentation. We'll wrap up with the actual creation of your plan, but first let's look at the other three keys: telling the story, personalizing, and cultivating.

Telling the story

You may hear fund development people talk about case statements. A case statement is the articulation of why you are seeking funds.

I've often found the term "case statement" to be somewhat intimidating. When communicating to your prospects, I encourage you to "just tell the story."

Let me give you an example. When I was working with an organization that serves youth at risk, our development program included direct mail solicitation. We had had average success with previous solicitations, which had been letters that described the organization and the services we provided. Last year we "just told the story": With the permission of his parents, we told Antonio's story. This story was a clear example of what we did, why we did it, and how it worked. The result? We more than doubled our average gift size and our total revenue from this solicitation.

Just tell your story—not in terms of what funding will do for your organization or how many positions you will be able to fill, but in terms of what financial support will mean in the end.

In your case it might be a cleaner river. But even that isn't the end. What does a cleaner river mean? More fishing? More public access? More clean water for a town? Find the end benefit, and just tell that story.

Personalizing

The second key is personalization. In his book, *Achieving Excellence in Fund Raising,* Henry Rosso points out the value of the old axiom: "People do not give to causes. They give to people with causes." (By the way, if you want a good resource book and you can only get one, this is the one to get.)

They give to people with causes. And they give to people who ask them, especially when those people are peers or individuals they respect for one reason or another. How does this fit into your program?

If you are going to seek funds through direct mail, there are a number of personalization techniques that work. Let me go back to the "Antonio" letter. We personalized it in three ways. First, all 2,200 pieces were personally addressed, both in the letter and on the envelope, through our laser printer. This was time- and labor-intensive, but it was worth it. Secondly, each letter was signed by our key volunteer—our board president, a man well respected in the community. Finally, we attached a "from the desk of. . ." note to many of the letters. Our board members had reviewed the list and indicated those they knew. In those cases, the note was "from the desk of" that board member. This level of personalization had an impact on the success of this solicitation.

Personalization of corporate solicitations comes primarily in the form of involvement of your volunteer leadership. This is frequently a member of your board, but it might also be a community leader who supports your cause and is willing to help. In the best of all possible worlds, you want to match your volunteer with the corporate decision maker. You want your volunteer, George, to be able to call Mary, the CEO of Company Z, on a peer-to-peer basis, get an appointment, make the presentation, and ask for the contribution.

Personalization of foundation requests is sometimes a little harder, depending on the receptivity of the foundation to calls. If you can identify who is on the board of the foundation, and if you have in your leadership or support group a friend of one of those board members, then that's the channel to use.

Cultivating

The third key is cultivation. (That isn't my favorite word, but it's better than one many use—"nurturing." Someday I'm going to find exactly the right word for this process.) If you think of it in gardening terms, the process is just what the words say. The seed has been planted (the donor has made a first contribution), and you want to make sure that donor stays

healthy and grows.

Do you talk to your plants? You'd better "talk" to your donors. Keep them informed. Let them know what is happening as a result of their gift. Keep telling the story. Donors have varying needs beyond knowing what is going on with your organization. All need a thank you. Some need more visible recognition—a plaque to hang on the office wall, membership in a special giving club, invitation to an event. Others are adamant about not wanting you to spend any money on that sort of stuff. Whatever their needs, it is important to discover them and supply them.

Planning

Finally we come to the topic that was the title of this workshop—fund development planning. Everything I've discussed so far can be part of your plan—just pick which components are right for your organization. First, though, there is a checklist to complete. Your organization needs to have, at the very least:

- A mission statement
- A Board of Directors
- Tax-exempt status
- The ability to do what you tell donors you are going to do

With these in hand, you are ready to begin your fund development planning. You will start with your overall plan; then each component will need its own plan. Finally, you need to mesh the timelines and budgets of each component so that you know you can do it all.

Planning can be intimidating. But it doesn't need to be. Your plan can be as simple as a listing of your goals and the activities that you will undertake to reach those goals. Just keep the SMAAC principle in mind: The goals and activities must be Specific, Measurable, Achievable, Acceptable, and Compatible.

So, decide how much you need to raise, and which strategies you are going to use to raise that money. That's your plan.

Here's an example:

Goals:

- To increase funding, over two years, enough to add a development director
- To increase contributions by $15,000 by the end of the year

Strategies:

- To conduct a 1994 direct mail campaign for donor acquisition
- To present a special event (dinner and auction) in October to raise community awareness and generate cash influx
- To seek four new corporate sponsors for programs by October
- To submit scheduled requests for ongoing funding to foundations currently supporting the organization

Sponsorship Plan:

- Identify potential sponsors
  - Research which local corporations support our cause
  - Research who the decision makers are for each
- Match Board members with potential sponsors
- Prepare all collateral materials by (date)
- Prepare Board members for presentations
- Obtain appointments for presentations
  - Send letter to corporate decision maker by (date)
  - Have follow-up calls made within a week of letter
- Make presentations
- Report results

This is a very simple plan. Yours will need to have more detail in it. Don't resent the time that it takes to do a plan because for every hour that you spend planning a program, you've saved yourself at least two in the actual execution.

Geographic Information Systems and Volunteer Monitoring Data

Moderator: **Jeff Schloss,** University of New Hampshire Cooperative Extension
Presenters: **Dave Drescher** and **Rosemary Furfey,** Portland Metro; **Liz Hoenig,** Stream Team; **Steve Johnson,*** PSU Community Research Center; **Jim Stimson,** Montana Natural Resource Information Systems

Dave Drescher
Rosemary Furfey
Portland Metro

Geographic Information Systems

Geographic Information Systems (GIS) blend several elements: hardware (computer), software, and data. GIS technology, which is only about 20 years old, is a tool to visualize and analyze data. Just as a word processor allows you to utilize tools such as a spellchecker and a thesaurus in writing a letter, GIS allows you to utilize a set of tools to look at data and make maps. The power of GIS is in being able to take data, visually display it, and look at relationships that exist among layers of data.

A distinction should be made between CADD and GIS, two similar technologies. CADD stands for Computer Aided Drafting and Design and may apply to a wide range of software/hardware configurations that can generate maps or schematics. CADD is useful at designing computer chips or blueprints for a house, or creating a sewer line schematic. You can change line widths or colors, easily update features, or calculate area—but it would be difficult to ask questions of the data. For example, in GIS a sewer line map tied to a soil map could tell you where breaks in a line might occur due to shifts of unstable soils. However, this type of spatial relationship (soil types to sewer lines) does not exist in most CADD systems.

Aerial photos and satellite imagery help us understand the connections between communities, both human and environmental. When we see the flow of rivers and location of mountains, it is usually obvious why cities evolved where they did. On a satellite image, Portland is seen nestled in between a steep ridge and a river, the river providing a cheap mode of transportation. These very informative hard-copy products can used as layers in a GIS. Many images are "smart"—each digital square, or pixel, in the image has a unique number, or spectral signature. Using GIS, the number combination can tell us if a stand of trees is hardwood or deciduous, healthy or stressed.

How GIS is used

Here are several examples of uses for GIS technology. The first is a map that links election results to a precinct map. Looking through sheet after sheet of a hardcopy output of "yeas" and "nays" means little, unless you are looking for just one or two precincts. But when you link the data to the map in GIS, patterns emerge, creating an immediate visual tool that could be used for many purposes, including focusing energies on educational opportunities.

Another use of GIS is for flow modeling, which looks at three-dimensional space. The St. Johns Landfill is closing down after some 40 years of use, and there is some concern about flow of leachates into surrounding areas. By taking data

*no paper submitted

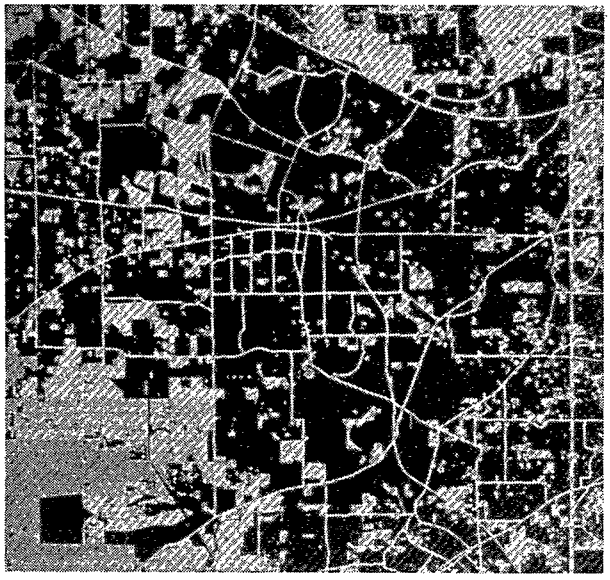


Figure 1. Undeveloped land.

from test holes drilled throughout the project site, continuous surfaces for sand, silt, gravel, etc., can be generated for input to a model. The different types of surfaces are important to delineate because leachates will travel at varying rates through different surfaces. When a slug of liquid is released in the landfill, you can track how far, how long, and how much the slug would disperse.

The next example uses GIS to help make land use planning decisions. Many layers of data can be combined to model urban growth planning. They include data on land use, tax lots, undeveloped land (see Figure 1), floodplain, steep slope, ease of access, and vacant land. Some of the layers were made using GIS tools, like steep slope and ease of access, while others were simply digitized or scanned, like tax lots and land use. The power of GIS here is in creating an interface that allows weighting the layers. For example, in trying to allocate population growth, you may need to consider that 100 percent of floodplain land is unavailable for development. In reality floodplains are built in all the time, with mitigation. By entering a new percentage, the model can be rerun to reflect changes based on new criteria.

GIS has taken the "black box" problem out of many decision-making conflicts. A developer and an environmentalist are usually at odds in terms of what should or could be developed. By making it possible to visualize data in map form, weight layers as to their importance, and run models depicting different scenarios, GIS helps concerned parties reach consensus more easily.

Another example of GIS creating good visual information is its ability to make shaded relief maps. Starting with USGS line and point data from digital quad maps, a "TIN" (triangular irregular network) is generated. The TIN is then converted to a lattice (file of regularly spaced points) and a hill-shading algorithm is applied to the lattice surface (see Figure 2). If a three-dimensional effect is desired, then the hill-shaded file can be draped over the tilted lattice. These products are very powerful in getting people to better understand where they live, work, and play.

GIS is great at cranking out numbers and data. For example, if you are interested in forming a watershed group, you could use GIS to generate maps and calculate acreages by steep slope, land use types, floodplain, etc. But if the watershed covers thousands of acres and has thousands of people, it can be overwhelming trying to get information out to potential members and supporters. Because GIS can easily calculate the distance from a person's address to a given geographic feature, such as a stream, you could create a mailing list including owners, addresses, and distance of property from the stream. Then for your first mailing you could select from the list just those people who live within 500 feet of the stream. The next time, you might mail to those that are 501 to 1,000 feet away.

GIS and volunteer monitoring

Here are two examples of how GIS might help the volunteer monitoring process. The first deals with site selection. When sites are chosen for testing, they are usually at an easy access point. Let's say that site number 1 is at a bridge. GIS can calculate, for all land upstream of the site, percentages of residential, commercial, industrial, and park/open space. You can then identify a downstream site that has similar percentages for your site number 2. Because the sites have similar characteristics, comparisons of collected data may pinpoint problems more quickly. Also, the precise calculated location for site 2 may not be very accessible. But by calling up information in the GIS on ownership, a map can be made to show best possible access spots.

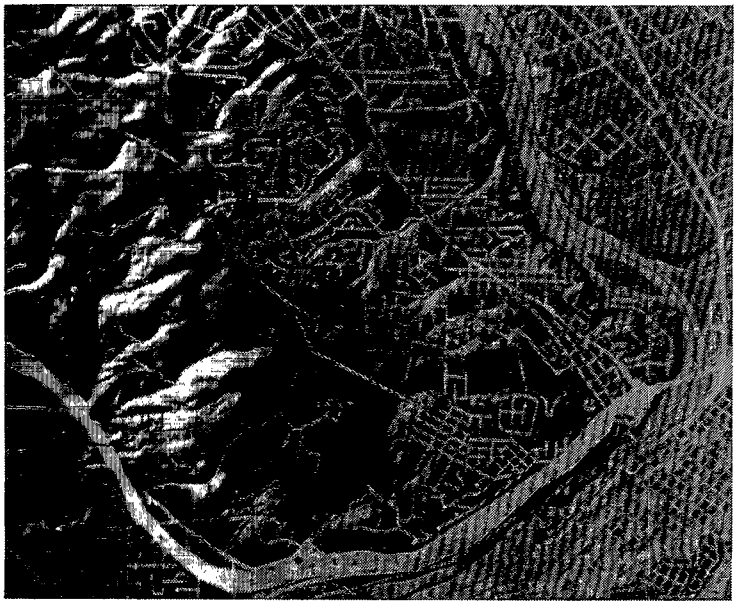


Figure 2. Shaded relief map.

Temporal change, or change over time, can very useful in monitoring water quality. If, over several years, water quality at site 1 does not change much, but site 2 has some major change, calculating new percentages of land use for the contributing area for site 2 may help pinpoint the source. Collecting water quality information generates a huge amount of data. GIS can easily manipulate and track all the information necessary to help make smart decisions. The best use of GIS is when data are collected more than once, or when observations are being compared.

The good, the bad, and the ugly of GIS

The "good" of GIS is that it helps to educate, and acts as a facilitator in the decision-making process. The "bad" is that data can be misrepresented and used incorrectly. The "ugly" is the monetary cost, which can range from a few thousand dollars to a million dollars. GIS in the volunteer monitoring process is not useful for everyone, but it is an essential part of the process.

Jim Stimson

Montana Natural Resource Information System (NRIS)

Using GIS to Support Volunteer Water Monitoring Projects

The Montana Natural Resource Information System

The Montana Natural Resource Information System (NRIS) was established by the Montana Legislature to simplify access to information on Montana's natural resources. NRIS is located in the Montana State Library and has three primary components: the Natural Heritage Program that focuses on rare and endangered plants and animals; the Water Information System that provides access to all kinds of information about surface and ground water; and the Geographic Information System (GIS) which focuses on using natural resource data in a spatial context. NRIS develops data management techniques and software to increase the accessibility of information and data. NRIS also specializes in applying the GIS technology to natural resource applications, especially in the area of water resources.

The primary goal for using the GIS is to make it easier to examine, evaluate, interpret, and display natural resource information. The following three examples show how NRIS uses GIS:

1. NRIS operates an information and data clearinghouse providing access to important sources of water information for Montana. When data users make a request, one of the first steps for NRIS staff is to determine if data exists in the area of interest to the users. To streamline this first step, NRIS maintains a number of statewide GIS layers showing the locations of data collection sites maintained by state and federal sources. The GIS layers include sites that are currently active and those that are not. Statewide maps can be accessed quickly and queried using desktop computers (Personal Computers or PCs) to determine if data are available to meet the users' request.

2. Maps of drought indices and streamflow were developed by NRIS to support Montana's drought monitoring and mitigation efforts. The maps can be used to quickly assess surface water supply and soil moisture conditions on a statewide basis. Figure 1 shows one of the drought monitoring maps.

3. NRIS is using the GIS to produce a groundwater atlas for the state. Atlas maps will show the distribution of impor-

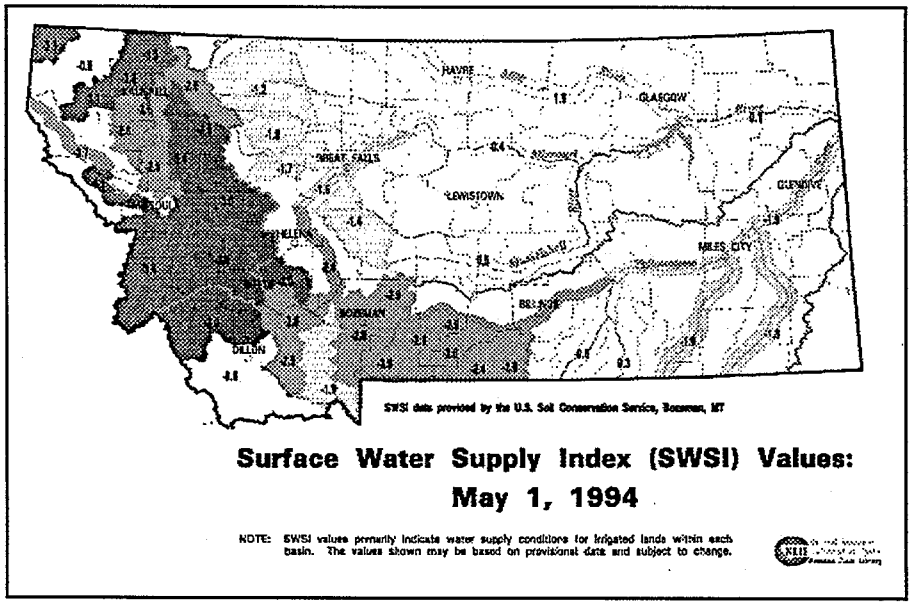


Figure 1. Sample Montana drought monitoring map.

tant alluvial and bedrock aquifers, general water quality, and potential threats to groundwater quality. Figure 2 shows one of the atlas maps.

4. The GIS has been used to map lands and water bodies that have special management status. These areas possess unique physical characteristics, and may also have rare and endangered animal and plant species and communities.

How NRIS uses the GIS to support citizen monitoring programs

Volunteer water monitoring groups are often interested in finding base-level, or background, information on their watershed or stream of interest. GIS is used to help volunteer groups gain an accurate perspective of their watershed. Maps are provided showing the location of the watershed and its hydrography, physiography, and general geology. Land- and water-use data are provided, when available, to help the groups assess the influence of human activities on water resources within the basin. The locations of existing monitoring activities are also useful to help prevent duplication of effort and create opportunities for cooperating with other agency and volunteer monitoring groups.

Advice for volunteer groups wanting to use a GIS

Several issues arise for groups interested in using a GIS to support volunteer monitoring efforts. First, *Do you really need a GIS, or do you simply need access to one?* GIS hardware and software are quite expensive. While prices for computer equipment and software have been declining for some time now, the cost of acquiring a GIS can still be a formidable obstacle. This is especially true for small citizen groups and most schools. Another issue to consider is the learning curve for GIS software. It requires a substantial commitment of time, effort, and funding to learn how to use a GIS proficiently. Not all volunteer groups have access to individuals who want to make this level of commitment to learn to use a GIS, or the funding to pay for training. In addition, acquiring and building GIS data sets can be very time-consuming and expensive. These costs can be, and often are, much larger than the combined costs for acquiring hardware and software, and training personnel. In light of these considerations, it makes sense for most volunteer groups not to own and operate a GIS. It's more feasible to look for a partner, or sponsor, to help provide GIS services for the volunteer monitoring project. Potential partners could include corporations, nonprofit groups, and state universities. Support could also be obtained from federal, state, or local agencies or programs that manage natural resources.

Clarifying how a volunteer group intends to use the GIS is important and helps determine if the group really needs a full-featured GIS. For instance, most people want to use a GIS to produce a map or a series of maps. It is important to keep in mind that a GIS is a very powerful data management and spatial analysis tool. Much of this power is unnecessary and wasted if all you need is a map. Don't misunderstand this statement. I am not dismissing or making light of the importance of maps for any project or group effort. Maps are very useful and powerful tools for communication. However, if map-making is your primary need, there are less expensive and less complicated PC-based GIS packages available. Some of these products provide the ability to enter and

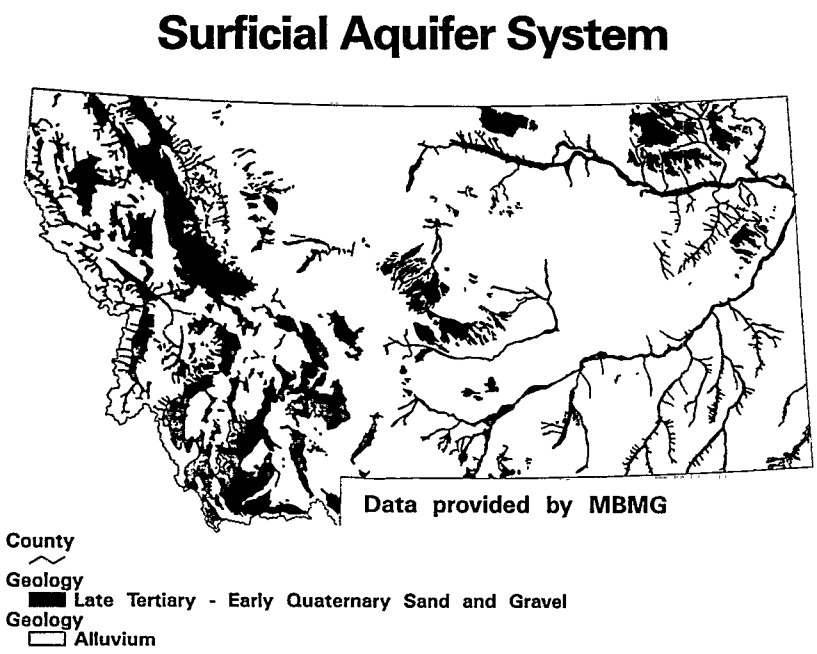


Figure 2. Sample Montana groundwater atlas map.

manipulate data, display map images and GIS layers on a computer screen, conduct data query and spatial analysis, and print maps. If you use one of these PC-based systems, you may still need access to a more powerful GIS to provide some functions or data layers, but you will not have to depend on it to serve the bulk of your GIS needs.

If a volunteer group is collecting data to input to a GIS, it is very important to consider how the location of data collection sites will be determined and recorded. In most states, geographic locations, such as land ownership boundaries, are recorded using the Public Land Survey System. Areas and points are recorded as Section, Township, and Range. These locations are really geographical areas and not points. When they are converted to a point coordinate system like Latitude-Longitude, Universal Trans Mercator (UTM), or State Plane, there is often significant error. Furthermore, a GIS cannot directly use Public Land Survey locations; it can only use a true point coordinate system location. Therefore, to save time and effort, volunteer groups should use one of the point coordinate system locations. Latitude-Longitude is very commonly used. The EPA River Reach numbering system will be available for use in the future and could be used to link monitoring data to a stream GIS layer. Instead of locating a data collection site by a point location, the River Reach system links sites to stream reaches that have been mapped and stored in a GIS format. For groups interested in using a GIS, the issue of which coordinate system to use is of paramount importance. Groups should prepare from the start to train volunteers to record locations using a true point coordinate system.

In summary, it is important for volunteer groups to determine how they will use the GIS to support the monitoring effort. Establishing a relationship with a partner or finding a sponsor to help provide GIS services is often the most cost-effective and time-efficient way for a volunteer group to utilize GIS. Finding a partner or sponsor should be done early in the life of a monitoring project, preferably before data collection is started. Less expensive and less complicated GIS systems are available for PC computers and can serve most of the GIS needs for a volunteer group. It is very important that locations for data collection sites are recorded in a coordinate system that is usable and supported by GIS. Latitude-Longitude is commonly used for this purpose.

Jeff Schloss

UNH Cooperative Extension–Lakes Lay Monitoring Program

GIS Applications for Volunteer Monitoring Programs: A Case Study

Earlier speakers have provided an excellent overview of what Geographic Information Systems are, where you may access the technology, and some discussion of limitations and costs. As GIS technology is relatively new, they also *suggest* some ways for volunteer monitoring groups to use the technology. What I would like to add to this workshop discussion is a real-life example of how citizen-derived monitoring data were actually used in a GIS watershed study. As you will see, GIS has a great potential for utilizing volunteer monitoring data. In turn, GIS can provide back important information that can both be used to improve volunteer monitoring strategy and be given to decision-makers.

The Squam Lakes study

As part of a model watershed study under the direction of the NH Office of State Planning, a multi-agency task force worked to create a GIS-based resource inventory of the Squam Lakes Watershed. The state's GIS system, GRANIT (Geographically Referenced Analysis and Information Transfer), is housed at the University of New Hampshire but linked to state agencies and regional planning commissions. Data "layers" input into the GIS included bedrock geology, hydrology (streams, wetlands, lakes, ponds, and aquifers), soils, elevation, land use zoning, land cover (from aerial photographs and satellite images), and wildlife habitat, in addition to a base map of roads and political boundaries. Also included was ten years of water quality data collected weekly during the ice-free season throughout the lake by volunteer monitors of the Squam Lakes Association under the direction of the NH Lakes Lay Monitoring Program. It was the availability of this water quality database that influenced the decision to conduct the model study on the Squam Lakes watershed.

Conventional GIS analysis—Land capability

GIS can be used to draw land buffer zones around streams, wetlands, and shoreline areas (with the size of the buffers depending upon local and state regulations). Thus a new GIS "layer" or map is produced containing all land that is restricted from development due to its proximity to a water body. The same can be done to show areas in the watershed with land that is too steep to build or that contains poorly drained soils inappropriate for septic systems. If you take these two layers of restricted land areas and combine them with layers containing the location of protected lands (parks, easements, conservation trusts, etc.) and land already developed, you now have a map of non-developable land. Superimpose this information over a map of the whole watershed and you are left with a map that displays all of the developable area remaining in the watershed. The GIS can also take information provided into its database on zoning (i.e., land area required for each house lot) by town and provide a "build out" scenario that can estimate the number of new houses the watershed could potentially have, as well as the increase in population!

When the above analysis was carried out for the Squam Lakes project, it was found that about 12 percent of the watershed was currently developed or protected and about 52 percent was constrained or restricted to development, leaving almost 37 percent of the watershed to be developed. While,

as a whole, the lake displays excellent water quality and is relatively pristine, there are areas within the lake with less desirable water quality conditions.

With this analysis complete, the problem was defined: Even though some areas of the lake are already showing signs of water quality degradation, current laws and regulations would allow development within the watershed to expand over three times the area of what is already developed. Based on this finding, the project recommendations included suggestions on taking into account land-based resources such as productive forest and agricultural soils and aquifer recharge areas. What was still needed was a method to locate critical *lake* areas and produce additional GIS products to assist decision makers concerned with water quality and watershed resource protection.

Geographic display of data and visualization

When the GIS was used to display volunteer monitor data of water transparency and algae bloom events on a map of the lake, it became apparent that many of the small coves and embayments were areas of more degraded water quality. The data suggested that the lake did not react uniformly to watershed inputs; that it was not just one big reaction vessel or "bathtub," as is commonly assumed for many large systems. This concept was further enhanced by taking the bathymetric map (depth contour plot) of the lake and using the GIS to create a 3-D model of the lake bottom (see Figure 1). No experience in topographic readings was necessary to be able to see how the lake was really made up of multiple basins connected together and that each of these basins had high sills around them. Many of these sills reached up to shallow water depth, well above the basin thermocline, effectively separating the bottom waters of the lake basins for most of the year. Thus the GIS allowed for the definition of lake basins within the lake system. Of the 18 lake basins defined, 17 had been monitored through the volunteer program, so further GIS analysis could be done.

Geographic referencing and spatial analysis

Now that the basins were defined, each basin could be linked through the GIS with its abutting subwatersheds. This allowed for analysis of what characteristics of the land around the basins had an influence on the basin's water quality. While we had the luxury of an extensive GIS database of land cover (down to the type of tree stand, from aerial photography!), we started with some basic GIS analysis using information that would be available in a more limited database. For each basin we found a good correlation between water clarity and the mean depth (derived from the GIS by dividing the surface area of the basin by the volume of the basin), and between algae levels and a combination of mean depth and the ratio of the basin surface area to the area of land that drained into it (abutting subwatersheds). This explained much of the data variation in all basins except for one (which we will get to later). Thus with some relatively simple data analyses we could define which areas of the lake react more critically to nutrient loading. Our preliminary land cover analysis revealed that land cover in the shoreland zone (a zone created by GIS at an arbitrarily chosen 250-foot distance from the shore) explains less water quality variation than the total subwatershed land cover. This implies that although shoreline regulations are important for the Squam Lakes (and most likely our other pristine lakes), activities *throughout* the watershed also have a significant impact.

In-lake resource inventories

Although water quality was one value that Squam Lake communities felt was important to protect, other aspects of the lake held equal if not greater importance. Squam Lake currently has the healthiest cold-water fishery in the state. It also has excellent small-mouth bass habitat. Moreover, the common loon plays an important part in the aesthetics of the area (the movie "On Golden Pond" was shot on location at Squam), and a great deal of support can be drummed up to protect this very charismatic species—even in a state with the

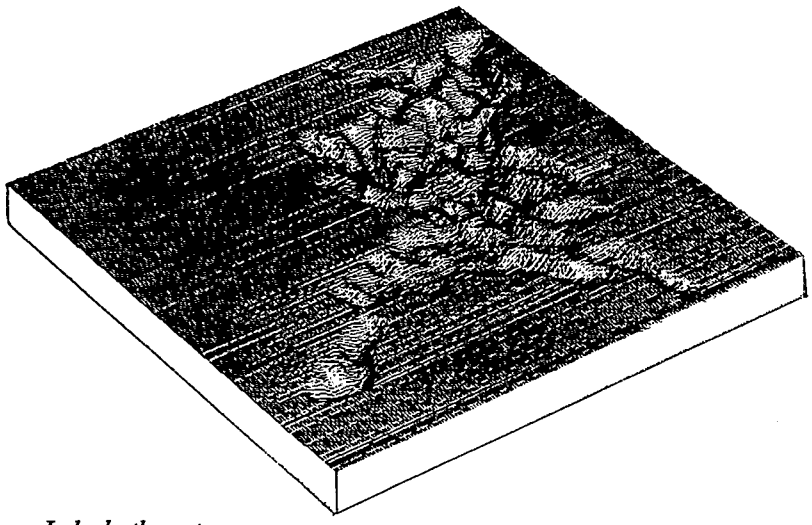


Figure 1. Model of Squam Lake bathymetry.

motto "Live Free or Die." To that end, a GIS layer of loon habitat (provided by volunteers of the NH Loon Preservation Society), bass nesting areas, cold water fish reefs and holes, and smelt brooks (from NH Fish & Game and volunteer surveying) was created. The GIS could then reference the various in-lake and shoreline wildlife extent contained in each of the basins.

Integration of the data layers

Now the GIS was complete with information on in-lake water quality conditions and wildlife resources. From this information the GIS was used to locate the lake's most critical areas. This was done by assigning a point value to each of the following basin or subwatershed criteria: mean depth, subwatershed-to-basin area, existing water quality, cold-water fishery habitat, warm-water fishery habitat, and loon habitat. For our study an equal weighting was used (based on a score of 0 to 4 for each of the above criteria), but the weighting can be modified to favor any criteria of greatest concern. For each basin and adjoining subwatersheds the GIS simply averaged together all of the criteria scores. The resulting integration was best visualized by draping a color (light or "cold" for less critical areas, reddish or "hot" for most critical areas) over the 3-D plot of the lake basins.

GIS products

Color slides such as those used throughout this presentation do the best job of visualizing the procedures and concepts of this study. However, the materials produced for the monitors and the decision makers have to be more functional because towns and most citizens still do not have easy access to GIS systems. Therefore a more "low tech" set of products was developed. For the town decision makers a map of the watershed area was provided, delineating the various subwatersheds and basins of the lake labeled by number. These numbers then are referenced to a printed table which contains the water quality and resource information of both the basins and the abutting subwatersheds (see Figure 2). Thus, instead of having to decide on the approval of a project based solely on information provided by the applicant, the decision maker can look up the subwatershed where the project is being proposed, check on the important lake resources that may be impacted, and have the applicant address specifically how they will minimize loss or impacts to that resource. (I have seen many development proposals with impact statements pertaining to wood-duck habitat or some other species that simply was not present or at risk; this system precludes that from happening.) The tabled information could also be captured to a spreadsheet or a database system if the town or monitoring group has one, and digital maps could also be provided to those with GIS display systems. To date, however, there have been no requests for products at this level of sophistication.

Using the information

Information gained from this study has benefited the lake association, the surrounding towns, and state agencies. The lake monitoring group utilized the GIS study to reevaluate its

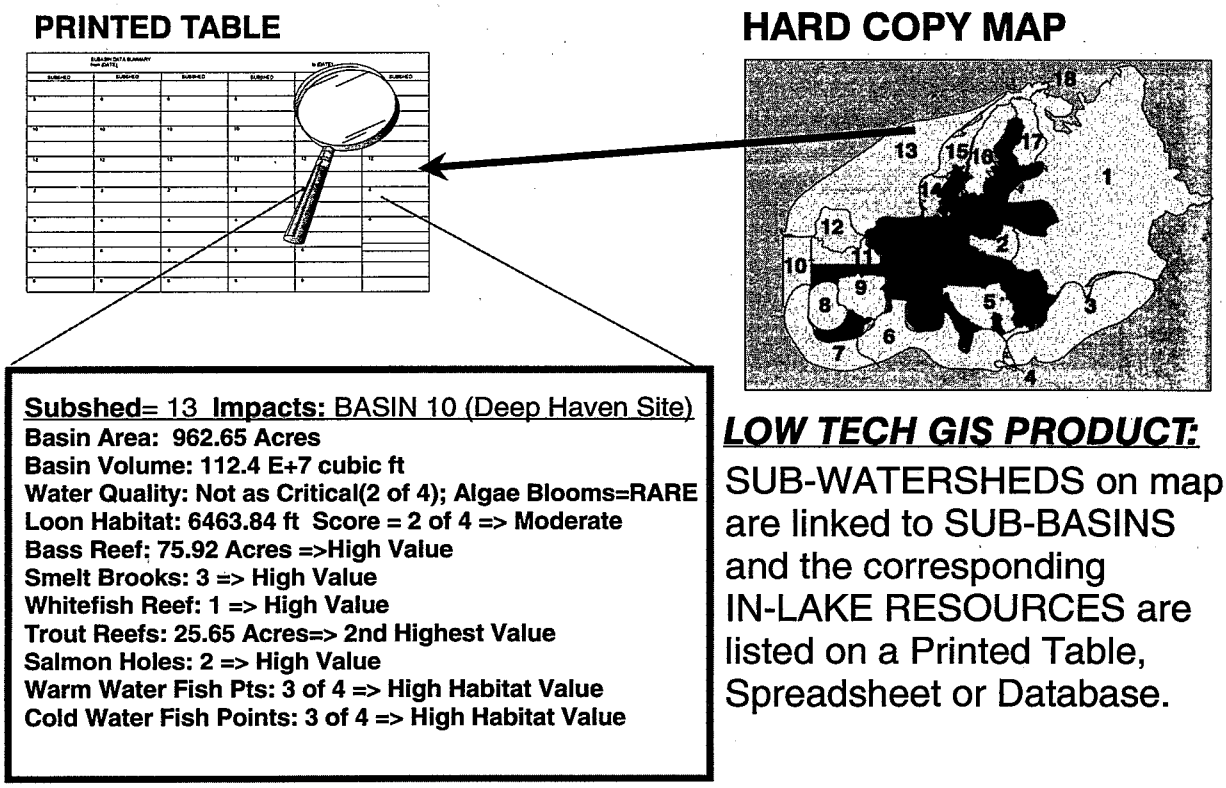


Figure 2. Low-tech GIS products provided to local government.

monitoring strategy; now the monitors conduct more frequent sampling at the "hot spot" sites. The lake association used the information produced to call for better enforcement of boat speed rules for the more critical areas defined by the GIS. One of the towns is reevaluating its zoning and planning laws in light of the results of this study. Information from the GIS study was used by our state environmental enforcement agency to evaluate their permitting of a development project in the watershed. As for the one basin that did not follow the expected outcome of the analysis, we later learned from investigation that a significant amount of fill used to cover over a wetlands area at the end of this bay impeded the flow of a tributary that acted to flush the bay out during the spring melt (wet) season. This was the only embayed basin with a restricted tributary.

Summary

The volunteer-collected data were critical for the majority of GIS analyses: for evaluating water quality throughout various areas of the lake, linking subwatershed and lake basin characteristics to water quality, and investigating relationships between land cover (or land use) and water quality. While GIS can be a powerful analysis tool, a great deal of information is necessary to take advantage of this power. Volunteer monitoring provides a very cost-effective way to provide the necessary data.

In turn, the GIS provided a land capability analysis for the watershed that defined the problem at hand. It allowed for the visualization of the watershed character, important in-lake resources, and water quality data. It also allowed for the determination of watershed-to-lake relationships and integrated all of the important data layers to delineate critical lake basins.

The results of the study were used to improve the sampling strategy of the volunteer monitoring program and address local concerns. Low-tech products from the GIS provided to local boards and commissions allowed for informed decision making, taking into account water quality and important in-lake resources. The usefulness of the study was also recognized by our state environmental enforcement agency.

A slide program of this model study has been developed to effectively present the approach and results to other communities in the state. It has been successful in motivating other watershed communities to conduct resource inventories and seek GIS support from state and federal agencies or regional planning commissions. Finally, and perhaps more importantly, participants in our volunteer monitoring program now better understand the importance of their data collection and the potential of their ever-growing database.

Plenary Session, Day Two

Deborah Alex-Saunders
Minority Environmental Association
Sandusky, OH

Diversity: A Special Challenge

Looking at the definition of the word diversity, the word *different* is the first word that comes to mind. However, the word *variety* stands out even more. Here in Portland, I've been very impressed with the natural diversity around us. Envision a field of roses, of many colors, with some elks grazing, and a bunny rabbit. This vision is pleasurable. Now let's change that vision to fields of people—old, young, handicapped, blind, black, white, and yellow. Does the picture still remain pleasurable?

Now let's envision a group involved in water monitoring. What will it look like? Chances are that the makeup of that group will look like the people sitting in this audience. There are few persons of color.

This brings us to the question, Why do we need diversity anyway?

The concepts of endangered species and endangered habitat are generally applied to animals—the eagle, the whale. But the African-American community suffers serious health ills from disproportionate exposure to environmental problems. The Commission for Racial Injustice 1987 study, "Toxic Waste and Race in the United States," reports that three out of four blacks and Hispanics live in communities with uncontrolled toxic waste sites.

This brings us to reason #1 for diversity: With their survival threatened, these people have the right to be part of the solution, not part of the problem. They have the right to be trained and used to monitor environmental problems in their community. An urban environmental program should be inclusive of urban dwellers.

Reason #2: There is a desperate need for key data. Uninformed and isolated minorities in such communities are not aware of these environmental emergencies. To address this issue, I am writing a book entitled *Violence: A Symptom of Chemical Contamination.*

Reason #3: Funding. The Federal Clean Water Act passed 20 years ago. Today, new laws and policies are focusing on U-R-B-A-N. This redirection to urban issues is more inclusive of people, not just plants and animals. Requirements for funding may include community action and citizen involvement—that is, targeting the diverse populations within the urban environment. Sustainability is an additional operations request. Funding amounts are connected to urban reuse and recycle.

Obstacles to be overcome

What are the obstacles that need to be overcome in order for us to diversify?

1. *Perception.* The biggest obstacle is perception. There is a story about two sisters who both fought for hours over an orange. Finally they cut it in half. But it turned out that one wanted to eat the fruit, and the other wanted the rind for cooking. Each failed to understand what the real desire of the other one was.

Who here does not want clean air and clean water? Please stand up. Who here will not share the orange?

There is a perception among the general public that people of color have not expressed concern for the environment. This gross misconception has been rooted in the narrow definition of environmental issues that has been advanced by traditional environmental organizations and the media. People of color have taken on environmental issues in the terms of human behavior. The artificial conditions of urban life have diverted their attention from animals and plants and concerns about pristine areas. But don't deceive yourselves that the underserved neighborhoods haven't asked, Why does everybody else's neighborhood seem to look better? Why are the streets cleaner? Why is the garbage picked up more often? Why is there more police service? For communities of color, environment is a question of the quality of life.

2. *Communication.* Communication is more than words. It is understanding culture. Times when people of color have cried out about the abuse of the land, the power structure has not respected our needs. African-American people have been made to feel they have no claim to the land. Where does the fault rest? It rests with the government, and also with mainstream environmental groups.

Most environmental legislation affects those areas that are the most polluted and generate the most concentrated forms of pollution—i.e., urban areas. However, the rhetoric and national strategy of the environmental movement often hide the fact that its true targets are cities. National environmental organizations often use wilderness areas, endangered species, lakes and streams to promote their political viewpoints. This contradiction is one of the major issues that must be faced by anyone putting forth an environmental agenda that seeks to bring diversity within their programs. There is a fundamental disparity between mainstream environmental ideology and urban reality for people of color. How do we interpret and send the message of urban environmental policy within the community itself? It's a major challenge.

Meeting the challenges

How can we overcome the obstacles? The first step is to accept diversity. Acceptance will overcome stereotyping and misconceptions.

I recently conducted a workshop in Boston. One participant was a young woman who was taking part in a stream restoration project with some inner-city youth. She admitted she was uncomfortable. "I tried to talk with them," she said,

"and in class we had some lovely discussions about diversity, but it just wasn't there. The white students sat on one side, and the blacks on the other. I just couldn't be one of them." My question to her was, "Do you really want to be one of them? Did you like the way they looked? talked? Would you trade places with them?" Her answer was, *"No!"* As we talked, she began to see that the way to feeling more comfortable was to realize that the information that they were about to share was the key—not the lifestyle, not the looks. "Accept the differences, embrace the data."

Other strategies for meeting the challenge of diversity:

- Tie your data in with human, urban issues. For instance, how does monitoring the upstream part of the river relate to downstream combined sewer overflow problems? Ask different community groups to review your material and comment on how it may be connected to what is happening in that community.
- Use intermediaries. If you are walking into unfamiliar territory, admit it. Get help from a group of people who can deliver your message. Countries do this all the time: They send in ambassadors. Organizations such as the Minority Environmental Association can support and assist you in communicating your programs. Call us.
- Don't make the mistake of hiring one sole person who is black and then expecting him or her to represent a whole community. Meaningful participation is the only way to achieve diversity.

In closing:

The wolf will chase the rabbit, the rabbit will flee the wolf, but neither wants the forest to burn down.

From Data to Action, Part Two: Working Together for Change

Moderator: **Jerry Schoen,** Massachusetts Water Watch Partnership
Presenters: **Jack Byrne,** River Watch Network; **Jerry Schoen; Marie-Françoise Walk,** Massachusetts Water Watch Partnership; **Ginny Barnes,** Audubon Naturalist Society

Jack Byrne
River Watch Network

Working Together for Change

Good water quality data is a very valuable resource, and you have a potentially powerful tool in your hands for affecting decisions. EPA's 1990 *National Water Quality Inventory* indicates that only 36 percent of the 1.8 million river miles in the U.S. were assessed by the states. That leaves 64 percent, or approximately 1.15 million miles, that did not get assessed.

That means that a lot of significant decisions about how to use land or waterways are made in the absence of any data about the conditions of streams and how the decisions might change those conditions. Volunteer monitoring data can help fill this gap. The information that you collect is more than likely the only information available, and it gives you a great advantage, if you use it properly.

Let me give you an example of how decisions are made with no data. Piney Brook, in Maryland, was a high quality stream whose water quality and habitat far exceeded the use classification assigned it by the Maryland water quality agency. However, this was not known or documented until *after* the land around it was developed for high density residential and commercial use, including the construction of major roads and a sewer line running 5 miles along the stream banks. Had there been data available they could have been used to document the exceptional character of Piney Brook and to assure that any development would have minimal impact on the stream.

Our goal is to improve or protect water quality. That means we either want to restore degraded waters or keep high quality waters in good shape. Through the Clean Water Act we have set a national goal of restoring and maintaining the physical, chemical, and biological integrity of the nation's waters. In order to reach this goal we have to know what the gap is between the current water quality and our desired water quality. Action for clean water is taken when people understand that there is a gap, or that there is a threat that a gap will be created, and are concerned enough to act.

These actions happen both collectively and individually. Collectively, we pass legislation and regulations to improve and protect water quality. Individually, we are guided by those rules, or, when they do not apply, we take our own individual actions. We should be using our volunteer data to help people see the gap, or the threat of a gap, between desired water quality and the way it really is—and doing it in such a way that they act to close the gap.

Volunteer data have many possible avenues for use. In the regulatory area, volunteer data can be used to affect legislation, to shape the way standards are developed, to influence permit decisions, and perhaps as evidence in court cases. This can happen at the federal, state, and local level, but for most groups the data are going to be most effective at the state and local levels. On the individual level, data can be used to educate people, to make them aware of the issues and what needs to be done to address them.

Let me give an example of how data have been used in both the regulatory area and to affect the actions of individuals.

Data collected by volunteers on the Ottauquechee River were initially used in a public relations campaign to get people to vote for bond money to build treatment plants and to get them to voluntarily repair failing septic systems. Then the data were used again 15 years later, in Water Resources Board hearings and in court, to oppose the classification of the river for treated waste discharge.

In the rest of this workshop, the panelists will talk about how to ensure that your data get used. Here are a few suggestions that I believe will put you in a better position for getting action:

- Clearly identify the issue you are trying to address and make sure your data are relevant to it. For example, if you are trying to restore or protect drinking water, what kinds of data would be most useful? (Fecal coliform or toxics would be very useful; temperature and dissolved oxygen would not be so relevant.)
- Define your desired outcome. Figure out how big the gap is between what you desire and what the water quality is. Highlight the gap and get people to start focusing on how to close it.
- Decide if you are the group to be the advocates or whether you want some other organization to use your data for you.
- Find out if you have laws and regulations to work with or whether you will have to use education and public opinion to get your views accepted. Learn the laws and regulations and how they have been applied in the past. Talk to others who have used the process if you are not familiar with it. Can these regulatory provisions be used to get you your desired outcome?
- Figure out who else you need to involve in your cam-

paign. Get them together and ask for their support, cooperation, funding, ideas.

- Have a realistic expectation about how long it will take to close the gap. If you want to get a farmer to change his management practices, that can happen in a shorter time frame than if you are trying to get an outstanding resource water designation for your stream.

Jerry Schoen,
Marie-Françoise Walk
Massachusetts Water Watch Partnership
Ginny Barnes
Audubon Naturalist Society

Data-to-Action Exercise

Water quality monitoring is an important tool in water resources management, but it's useful only if the results get to the appropriate decision makers. Many volunteer programs do not fully realize their potential because they devote too few of their energies to using the data they collect.

In this session, we will step through the choices a group typically confronts when using its data to influence water quality decisions.

Here's how the exercise works: We'll build a matrix that illustrates the path you take from having data to having a safe and sound aquatic ecosystem.

(Please note this is an exercise in data *use*, not data *interpretation*. We are assuming you've successfully collected, managed, and analyzed your data.)

In the matrix that we've developed, we've broken the data-to-action process down into five distinct "decision areas," each of which requires some choices, some action, and some expertise.

1. **Law/policy/practice.** We start off with defining the *decision-making framework.* In general, what is the process for resolving water resource problems in your watershed? More specifically, what laws, policies, and practices are relevant to the issue you are targeting?

2. **Decision makers.** Whom do you want to influence? (the players). For the laws and policies you have identified as relevant to your issue, who are the decision makers? A federal or state agency? A local board? A watershed group? An individual?

3. **Remedy.** What does it take to actually fix the problem you've identified? Remedies can be structural (e.g., fix a sewer leak), regulatory (pass a septic system maintenance ordinance), or behavioral (encourage landowners to refrain from cutting down streamside vegetation).

4. **Action to take.** Once you've identified the players and the remedies, your activist campaign really begins. Here's where you hold a press conference or present your data at a public hearing. Which you do depends on what kind of organization you are, and who your audience is. Try for a convivial solution, but prepare for combat if you must.

5. **Presentation strategies.** For each audience that you target, make sure you present your information in a style which they can appreciate. Consider data as "infotainment," and decide how much information or entertainment works best for each audience. Professional skeptics might want your raw data, with supporting statistical analysis, QA/QC reports, etc. Joe Q. Sixpack would rather catch it on the evening news, in the form of a colored map of the watershed showing pollution hot spots.

For all of the above steps, you shouldn't feel your group needs to have all the answers. At each step, consider *sources of help* that exist to help you find answers you need. Sources of help can range from like-minded organizations that you form coalitions with to an electronic bulletin board that gives you access to information on best management practices to control farm runoff.

Case Study #1: Eagleville Pond Association

Let's put this data-to-action process to the test, by using real-life examples. We will first go through two simple case studies to get familiar with how this exercise works, and then we will open up to the audience for your examples, which may or may not be as straightforward.

Our first example comes from the Eagleville Pond Association, one of the groups that Massachusetts Water Watch Partnership works with. This group had a typical problem—excessive aquatic vegetation due to very high levels of nutrients. The pond association had monitored for pH, alkalinity, dissolved oxygen, phosphorus, and nitrates. Their

Law/policy/practice	Decision makers	Remedy	Action to Take	Presentation Strategy

From data to action: A step-by-step matrix

results indicated very low dissolved oxygen levels and unusually high levels of nitrates. Their monitoring efforts pointed to a farm runoff problem on one of the pond's tributaries. Let's go through the matrix steps and see how this group approached the problem.

Step 1. Law/Policy/Practice

The Clean Water Act deals with water quality problems, including eutrophication. In Massachusetts, wetlands, including streams and ponds, also fall under the auspices of the Wetlands Protection Act. Eagleville chose to use the Wetlands Protection Act as part of their strategy.

If a group is unaware of the laws and policies in their area, whom can they go to for help? In Massachusetts, Riverways, a branch of the state Division of Fisheries and Wildlife, is a good resource, as are Massachusetts Audubon, the Congress of Lake and Pond Associations (COLAP), which exists in other states, the Massachusetts Association of Conservation Commissions (chock full of volunteer lawyers!), and NALMS (North American Lake Management Society).

Step 2. Decision makers

People or agencies who have direct influence in this matter include the farmer himself, the local Conservation Commission (which administers the Wetlands Protection Act), and the Department of Environmental Protection (DEP).

Step 3. Remedy

What could be done to improve the lake's water quality? (1) Stop the enriched runoff from the farm from reaching the tributary through best management practices (BMPs); (2) Devise a lake management plan (most likely chemical treatment to kill the weeds).

To get help in finding a remedy, various groups and documents are available: County Conservation Districts can help with BMPs, as can SCS and the Megamanual (a document produced by Massachusetts DEP). County foresters are also available if the problem is in a forested area. Electronic Bulletin Board Systems are a growing resource for people with access to a computer and modem to communicate with colleagues and interest groups and obtain information.

Step 4. Action to take

The pond association went for the logical, if not the easiest, option to reduce the farm runoff. They could have gone directly to the farmer with the information they had gathered, but knowing that he was uncooperative, they went to their local Conservation Commission for redress. They also could have chosen a less direct way, such as alerting the media, educating the general public about the situation, or talking at the Town Meeting, but they were prepared to make a good case to the Conservation Commission.

If a group needs help in determining what action to take, COLAP and MWC (Massachusetts Watershed Coalition) are two good resources.

Step 5. Presentation strategies

What presentation techniques are best to use in the present situation? Eagleville did an oral presentation to the Commission, bringing their data in the shape of simple graphs. They also brought a support letter from the Massachusetts Water Watch Partnership (MassWWP), and documentation showing results from an external professional lab, which had sampled at the same time as the volunteer group, keeping an official chain of custody. This helped validate the volunteer data.

Was this a success story? The Conservation Commission did mandate the farmer to install some BMPs on his property as a result of Eagléville Pond Association's presentation.

Case study #2: Herring Run

A second case study is one that was presented in "Data to Action, Part One" (Session Two): the Herring Run project in Maryland. Herring Run is an urban stream with degraded water quality. Its problems are more complex than Eagleville Pond's because they are multiple. The monitoring group has done a shore survey (as opposed to water quality monitoring per se) and found pipe outfalls, exposed sewer lines, overflowing sewer lines, fish migration barriers, erosion, trash, and unshaded stream sections.

For this exercise we will concentrate on their finding stretches of unvegetated streambanks. Even without water quality data, we know that an unshaded stream can support little aquatic life, due to increased temperatures and decreased dissolved oxygen levels.

Step 1. Law/Policy/Practice

This type of degradation is regulated by the Clean Water Act.

Law/policy/practice	Decision makers	Remedy	Action to Take	Presentation Strategy
• Clean Water Act • Wetlands Protection Act	• Farmer • Conservation Commission • DEP • Lake association	• Best management practices • Lake management practices	• Public testimony to Conservation Commission • Educate lake residents • Educate public • Appeal to DEP • Town meeting	• Supporting letter from MassWWP • Data graph • External lab QC check

Case Study #1: Eagleville Pond Association

Case Study #2: Herring Run

Law/policy/practice	Decision makers	Remedy	Action to Take	Presentation Strategy
• Clean Water Act	• Agencies: City of Baltimore DPW; county DPW; city Dept. of Rec. and Parks; state agencies • Abutting land-owners	• Tree planting plan • River cleanups	• Present data to state agencies, DPWs, and City Council • Present data to landowners • Raise public awareness	• Report sent to agencies • Slide presentation to City Council (televised) • Slides, overheads, maps for public meeting

Step 2. Decision makers
A lot of the stream corridor is owned by the city of Baltimore, and the rest is privately owned, so the decision makers include the City of Baltimore Department of Public Works (DPW), the county DPW, the Baltimore City Department of Recreation and Parks, and state agencies for the publicly owned stretches. Obviously, for the privately owned stretches, the landowners are the decision makers. A resource for help was Maryland Save Our Streams.

Step 3. Remedy
Two remedies that the group has targeted so far are tree planting plans and river cleanups. A great resource for tree planting in this case was TREEmendous Maryland, a state organization that provides seedlings, volunteers, and money to plant the trees. In other states, I would start by contacting the Soil and Water Conservation District, who can help with advice, maybe some money, and by donating seedlings.

Step 4. Action to take
Actions that the group took include data presentation to state agencies and to the DPWs, and an oral presentation to City Council (executive branch of government). They also targeted the private landowners by holding a public meeting and organizing a storm drain painting event.

Step 5. Presentation strategies
The data presentations to state agencies were in the form of a report. The presentation to City Council was a slide presentation, which was filmed by the local television station. At the open meeting for landowners, slides, overheads, and maps were used to illustrate their findings.

Using the matrix

In applying the step-by-step matrix that we have presented here, remember that it may be necessary to redefine the problem several times or divide the problem up into components. A solution may take years, and may not be the one you imagine. The matrix ought to operate with time loops going back again.

The potential value of this matrix is that it gets you to articulate. The remedy is rarely straightforward. It is more likely convoluted and complex. There may be short-term solutions, long-term solutions, or no solutions. You may learn that what you are engaged in is basically consciousness raising. You may have to engage in a lot of that before solutions are possible.

Committing to Diversity, Part One

Moderator: **Meg Kerr,** University of Rhode Island Coastal Resources Center
Presenters: **Bill Stapp,** GREEN; **Deborah Alex-Saunders,*** Minority Environmental Association; **Elizabeth Waters,** Waters Consulting Group

Dr. William B. Stapp
Global Rivers Environmental Education Network (GREEN)

Working with Diversity in Project GREEN

We as a society need to respect and value differences, be they based on age, class, gender, race, religion, ethnicity, or other difference. Recognizing and honoring diversity is a key to success. It's not a burden to be borne, but an opportunity to be pursued. One of the values of diversity is to bring in different perspectives. This gives you a much more holistic view of an issue. When you bring different groups of people together and really listen to their different experiences and thoughts, this increases perspective-taking. It increases curiosity about that issue. It increases creativity. It increases valuing. It increases problem solving.

It was the concept of diversity that first attracted me to the concept of watershed monitoring with school programs. Watersheds—all watersheds—start out with small tributaries, in a rural area; then the tributaries come together and begin to have enough water to support small communities; then pretty soon we find ourselves in suburbia; and eventually we come to the city, where there is adequate water for industry and for meeting the needs of a variety of people in a large community. Almost without exception, every major city in the world is in the lower parts of a watershed.

The Rouge River watershed, in the Detroit area, is only 20 miles by 30 miles—a relatively small watershed—but in it live 2 million people. In the rural areas of this watershed, average income levels are around $30,000 per year. Then in the suburbs, average family incomes are about $200,000 per year. In certain pockets of the inner-city community, average family incomes are about $8,000 per year. The rural areas are mostly white; the suburbs are mixed; and the inner city is mostly black. So you have a tremendous diversity within the watershed.

In Project GREEN, we try to maximize the opportunity to work with that diversity by linking together schools in different parts of the watershed. And with the use of computer networking, we can bring in other watershed groups beyond the schools—governmental agencies, citizen organizations.

[Editor's note: For a full description of Project GREEN, please refer to William Stapp's presentation in "Committing to Diversity, Part Two: Success Stories" (Session 4).]

Here are some techniques that Project GREEN has used successfully to incorporate diversity in our programs:

Step 1: Start with a high degree of diversity. When GREEN starts a monitoring project in a watershed, we try to include in the initial planning group all the diversity that we have in the watershed—rural, suburban, and city; range of income levels; the various ethnic communities; elementary, secondary, and tertiary schools; the general public; major decision makers; and environmental managers.

Step 2: Use computers to link students at different schools.

Step 3: Bring all the schools in a watershed together physically in a Student Congress. At the Student Congress, the students break into smaller groups, each one including students from schools in different parts of the watershed, with no adults present. They talk in their own way about how they feel about what is happening in their part of the watershed.

Step 4: Take action. Action is the problem-solving process that pulls everything together. Students work together to weigh different alternatives as they develop the action plan.

Elizabeth Waters
Waters Consulting Group

Overcoming Obstacles to Diversity

Why is diversity essential for all environmental groups?

Environmental issues are universal. Diverse groups of people—people of color, the disabled, lesbians and gays, poor people—are members of the universe. Everyone is impacted by environmental issues.

Individuals who have made the choice to champion environmental issues have assumed a leadership position. It is the responsibility of leaders to educate and involve a diverse group of individuals in the solution to save the universe. Without that diverse participation, the efforts of environmentalists will be meaningless.

In terms of people of color, historically we have seen the devastating impact in those communities where dumping, hazardous wastes, and so on have occurred. As Malcolm stated, "When white America gets a cold, black people get pneumonia." We can substitute Hispanic/Latinos, Asians, Native Americans. The bottom line is that without addressing the issue of diversity, the universe/planet will not and cannot be saved.

**Note: Deborah Alex-Saunders participated as a panelist but did not make a formal presentation.*

What are the obstacles to overcome to diversify successfully ?

The primary obstacle to overcome in addressing the issue of diversity is the inability to acknowledge that unless environmental groups diversify, the battles and wars to preserve the environment will be lost.

Intellectually many will say "But of course." However, when you look at the makeup of environmental groups you can see that the need for diversity has not been internalized to the level it needs to be. I ask you to take a look at environmental groups locally and nationally and count on more than one hand—maybe two—how many people of color, lesbians and gays, disabled are integrally involved at every level of the organization. A common response to this is, "It's not a priority issue for them because . . ." The "because" has to do with many of the obstacles the organizations fail to address, such as:

- ***Language barriers*** - When I worked for different governmental agencies, one of the ways we alienated people was to talk "bureaucratese" (i.e., use initials and terms familiar only to those who were a part of the system). Mind you, we did not get up in the morning and say, "Let's alienate the people we come into contact with." However, the impact was the same.
- ***Lack of diversity in key leadership positions*** - If I don't see someone who looks like me as a part of the decision-making process, why would I trust that the group will or can address my issue?
- ***Intolerance*** - I don't have to be a member of a radical political party or a registered Democrat in order to champion the cause of environmental issues. A big obstacle for groups to overcome is the need to have people look alike, think alike, and act alike. Imagine an environmental group (particularly alternative) that allowed members who were anti-choice and registered Republican! I have several family members who fall into that category. They believe in recycling and are committed to saving the universe in their own way. If we are being intolerant, we are not going to educate. If we judge and condemn people, they won't work with us.
- ***Low wages*** - Poor and working people, in spite of their desire to work for grassroots environmental causes, don't have that luxury with the wages that are paid. Single heads of households who don't have inherited wealth cannot live off the wages.
- ***Informal networks*** - If decisions are made outside of meeting processes, newcomers will be excluded. It's alienating to a new member to come to a meeting and find that all the decisions were made before the meeting.
- ***Recruiting one or two people of color to serve on boards*** - Diversity is not about getting one or two and saying "We're done." I have been the only woman of color on some boards, and somehow the responsibility of addressing the diversity issue becomes my responsibility. If the commitment to diversity is there, addressing it will become a shared responsibility.

Methods program managers could employ to overcome obstacles

1. Develop a five-year plan with timelines, monitors, and indicators identifying how the organization will diversify. Keep it simple and be realistic. A good starting point is to review your literature and the art in your office and make sure they represent diversity.
2. Develop linkages with diverse organizations, identifying efforts you can work on collaboratively.
3. Develop culturally based, family-focused outreach and educational programs. For example, if the Urban League has a youth program, your organization can develop an environmental education and outreach program for youths. Let people see that you care about their concerns.
4. Formalize the hiring process, increase wages, and use outside people to assist in the hiring and recruitment process. Don't just hire people you already know.
5. Diversify management and board of directors.
6. Ask questions and take risks. Don't assume you know what others want or need.
7. Continue attending sessions such as this one. Never decide that you know, and are doing, enough to address the issue of diversity—because even if you have achieved the goals within your organization, until other organizations have achieved similar goals, you have work to do.
8. Formalize your meeting process.
9. Develop a mentor/buddy program for new board members to increase diversity on the board.
10. Have fun. Make your organization something people want to be part of!

Building Partnerships with Local Government

Moderator: **Eric Mendelman,** Partnership Coordinator, Texas Watch Program
Presenters: **Alice Blatt,** Friends of Wetlands; **Anna Dunbar,** City of Sugar Land; **Ivy Frances,** City of Portland Environmental Services; **Dr. Jeffery Gottfried,** Fans of Fanno Creek

Eric Mendelman
Texas Watch Program

Alice Blatt
Friends of Wetlands

Anna Dunbar
City of Sugar Land

Ivy Frances
City of Portland Environmental Services

Dr. Jeffery Gottfried
Fans of Fanno Creek

The session on "Building Partnerships with Local Government" was structured as an interactive workshop with the following three goals:

1. to understand the benefits of partnering
2. to clarify the types and characteristics of partnerships
3. to provide tools for improving partnerships

Role play

A role play between an "activist" and a "city official" illustrated that *failure* to partner successfully results from:

- not listening
- defensiveness
- drawing conclusions prior to meeting
- not seeing the other person's point of view
- not offering solutions

The role play was resolved *successfully* when both parties:

- agreed that an environmental problem existed
- used inclusive language (e.g., "our" problem)
- came to the meeting prepared with information and resources
- came to the meeting with open minds
- showed respect for each other

Presentations

Following the role play, the panelists gave brief presentations focusing on the characteristics of partnerships.

Ivy Frances discussed formal versus informal partnerships. In a formal partnership between an agency and a citizen group, the agreement is put in writing and expectations are clear. Typically, a formal partnership results when an agency has one or more established programs already in place. When citizens approach the agency, they can be included in one of these existing programs.

Formal partnerships may lack flexibility and may not be able to respond to an immediate need as well as an informal partnership. Ivy gave the following example of an informal relationship: A local school was building a jogging trail and planned to put the dirt into an adjacent wetland. One of the teachers called Ivy. Ivy's agency was able to provide resources to get a dumpster to the school and get the sod recycled. This informal relationship successfully solved the immediate problem. A drawback to informal partnerships is that they may last only as long as the individual with whom the citizens have the relationship stays with the agency.

Jeff Gottfried discussed the benefits of one-on-one partnerships. Often an activist can help a well-intentioned government employee by applying public pressure on the agency when the staff person does not have the influence to stop a bad decision. Citizens can also help agencies by speaking about them in public meetings.

Alice Blatt discussed how important it is for partnering organizations to give something up in order to gain the broader benefits of partnership. When organizations are not willing to give something up in the partnership, they end up in a lose-lose relationship. Giving something up will more likely bring about a win-win. Alice described the watershed council that her organization is developing as a win-win for all participants. She emphasized that an important key to a win-win partnership is to get everyone who has a stake together in the same room at the same time.

Anna Dunbar discussed how partnerships can deal with pollution problems when both partners do not have the power to solve the problem. Drawing in additional organizations in the watershed can bring more resources to solving the problem. Action protocols can include these additional partners.

Elements of successful partnerships

Participants identified these elements of successful partnerships:

- mutual respect
- use of inclusive language
- incorporation of citizens in existing programs
- clear, well-timed communication around urgent issues
- use of public input on important environmental decisions
- clearly defined roles and responsibilities
- scheduling forums in which all partners get the same message at the same time
- developing protocols for dealing with problems that neither partner has the power to solve

Managing Your Data: Some Basic Principles

Moderator: **Jay West,** Izaak Walton League
Presenters: **Ken Cooke,*** Kentucky Water Watch; **Janice Miller,** Unified Sewerage Agency; **Trey Murff,*** Texas Watch Program

Janice Miller
Unified Sewerage Agency

Data Handling Procedures

What should be on the data sheet?

A few important items that should be included on volunteer data sheets are:

- The exact location of the site. (If nothing else, at least have the volunteer provide precise instructions on how to drive to the site.)
- Recent weather conditions. A recent storm can have a major effect on the data.
- Actual readings from the equipment, and any formulas used in calculation—**not** just the final answer.
- Anything unusual that was seen—spills, new construction, a dead animal, etc.

Reporting results

Don't report values of zero. Report "less than _____" (fill in the blank with the smallest value). For example, if the range of a test is 0 - 1 mg/l, the smallest increment is 0.02 mg/l, and the test result is zero, report as "less than 0.02 mg/l" (or "< 0.02 mg/l").

Calculations

Significant figures: Report the answer using only the appropriate number of digits. Remember the following:

- Constants do not impact on the number of significant figures.
- If you perform a series of calculations, carry two extra digits inside the calculations.
- When working with a series of values, each with a different number of significant figures:
  - for addition and subtraction, round to the least number of *decimal places* in the series
  - for multiplication and division, round to the least number of *significant figures* in the series

Rounding: Round your final answer. Use only one digit past the significant digit to determine how to round the last significant digit.

Reporting units

Watch your reporting units and write down conversion factors: "1,000 ml/liter," not just "1,000."

Be sure to report the correct chemical constituent. For example, if you require results for phosphorus but the test kit you use gives results as phosphate, it is important to convert the test kit value to phosphorus.

Atomic weight of oxygen = 15.9994
Atomic weight of phosphorus = 30.9738
Molecular weight of phosphate (PO_4) = 94.9714

To convert phosphate results to phosphorus results:

(Atomic weight of P/Molecular weight of PO_4) x (value of PO_4) = value of P

How much variability can you expect in a test?

When you select a test method, try to find one in which the results that you expect, or that are important to your program, are in the middle of the test range.

Example:

Range	Smallest increment	Translation
0 - 100	1	The smallest measurement difference you can measure is 1
0 - 10	0.1	The smallest measurement difference you can measure is 0.1
0 - 1	0.01	The smallest measurement difference you can measure is 0.01

Your best quality control will be achieved on samples with values in the middle of the range.

Example: You analyze 6 samples in duplicate using a test method with a range of 0 - 100 and for which the smallest increment is 1:

	Readings 1 & 2		Difference	Relative % difference
Sample 1	3	4	1	28%
Sample 2	5	6	1	18%
Sample 3	10	11	1	10%
Sample 4	20	21	1	5%
Sample 5	50	51	1	2%
Sample 6	80	81	1	1%

For each sample, the actual difference between reading 1 and reading 2 is 1 (the smallest increment you can get with this test). But at the low range this is a large relative difference. The same quality of work will give you lower quality values at the low end of any test range. The apparently higher quality work at the upper range of the test is not in fact higher quality data.

In general, good quality data will be reproducible within

*No paper submitted

± 5% to 10% when done by the same person (or ± 10% to 20% between labs).

Role of the coordinator

The coordinator should oversee the work, and collect all the field sheets and check them for completeness **before** the volunteers leave. Missing information should be added (or an explanation of why it is missing written on the sheet).

Volunteers in the field should get used to doing all their own calculations. There should be enough information on the field data sheet to allow them to do this.

It is very important for the coordinator to *check all the calculations before transferring the information to any database or spreadsheet.* You would be surprised how many errors are caught at this point! The sooner after the field work you do this, the more likely you will be to resolve any problems.

How to store the data

Enter as much information as you can into a database or spreadsheet. Set up comment fields for text. Organize the database so it is self-explanatory, or document it well.

If your budget allows, try to use a database or spreadsheet that is commonly used by both the professionals and the volunteers so that the data can be shared. If that is not possible, use one that allows you to transfer data out of your system in a comma-delimited form.

Don't throw away any field data sheets. Someone needs to be willing to be the keeper of the data. These sheets are the primary records, and anyone genuinely interested in the quality of the data may want to see them.

Check for accuracy

Print out the data and then, if possible, have someone else check it against the original paperwork. Basically they are looking for keypunch errors. If no one else is available, checking it yourself is better than not checking it.

It's worth taking the time to ensure accuracy, because once data gets into a database, it has a life of its own. People believe data that's in a database.

Screen for outliers

Screen the data for outliers by comparing it to past data from the same site or similar sites. Visually scan the data, looking for values that are off by a factor of 10 or 100. Look at the minimums and maximums and see if anything jumps out at you. Calculate a mean and median. If they are very different, you probably have an outlier. Graphing data points is an excellent way to spot outliers.

Screen for consistency

You should check for consistency between similar parameters. For example:

- Total solids should be greater than suspended solids.
- Total phosphorus should be greater than ortho-phosphorus
- Total dissolved solids and conductivity should track together (i.e., go up or down together). If one goes up and the other goes down, something is probably wrong.
- Total solids and turbidity should track together.
- The chemistry should match what was visually seen in the field (construction, recent storm, etc.).

Also check to make sure that data values are possible values for that test, and that they make sense. For example:

- pH greater than 14 is not possible.
- Check that temperature range is appropriate for reported scale (Celsius or Fahrenheit).
- Dissolved oxygen should not be greater than 20. Any value over 12 should be checked (a value over 12 is possible if there is a great deal of algal growth).

Fix the problem

If the data shows inconsistencies or doesn't make sense, follow up on the problem. If you can track down and correct the error, fix it and note that you fixed it on the field data sheet. If you really suspect the data is incorrect but you can't figure out the correct result, remove it from the database and note on the field data sheet that you did so. But don't take data out simply because you don't like it. We use a "Q" code in the database to flag data that is questionable but not demonstrably wrong.

If you correct an error, alert others to whom you have given the data so they can fix it too. Again, remember that data in a database has enhanced credibility and "a life of its own."

Fundraising, Part Two: Training Fundraisers

Abby Markowitz
Maryland Save Our Streams

Sooner or later, most of us have to deal with the frightening and sometimes distasteful subjects of money and fundraising. Unfortunately, money to initiate and maintain programs doesn't fall from the sky or wash up on the shoreline or streambanks simply because our work is important. In addition, most of our programs cannot rely on foundation or government grants for complete funding.

This means, then, that we have to actually get up our nerve and *ask individual people for money*. It also means that unless we want to do everything ourselves, we have to *ask other people to ask for money* on behalf of the program or organization. Further, if we want to be successful, we have to *train people to ask for money* and *design campaigns* that provide a forum for asking.

This intimidating process is known as grassroots fundraising and is the subject of this session. Generally, the term "grassroots fundraising" is defined as ongoing or sporadic small-donor ($500 or less) campaigns in which the donors are individuals, families, or small groups with a potential or known interest in the objectives and work of the group asking for money.

So, you've decided to wade into the waters of organizing a grassroots fundraising campaign. Contrary to certain ideas, this is an admirable endeavor. You are not selling encyclopedias or vacuum cleaners, nor are you a bill collector. You are working to implement and maintain programs that will bring about positive environmental change. In short, your organization is working to protect and restore our waterways and the watersheds that sustain them. This work requires resources, one of which is money. It is important to keep these ideas in mind—and communicate them to others—throughout the process of organizing and implementing fundraising campaigns.

Before you can train fundraisers, you have to recruit them. *Everyone connected to the organization or program should be asked to participate in some kind of fundraising event or campaign.* Assemble a committee of people—volunteers, board members, staff, friends, etc.—who have the responsibility to decide what type of campaign to implement. Set reasonable goals for money raised and numbers of volunteers needed to reach the goals.

The table on the following two pages lists some common types of grassroots campaigns along with important considerations and some of the pros and cons associated with each type.

Remember that regardless of what type of campaign you choose, people will be asking for money in one form or another—whether they go to the local grocery store to solicit an ad, talk to a stranger over the phone, or chat with co-workers about creative holiday gift-giving opportunities. However, different people are more comfortable with different types of asking. Some like asking people they know and others prefer asking strangers. Your potential volunteer fundraiser base may be a consideration in choosing one campaign over another. Also keep in mind that in many ways *asking is asking,* whether you are asking someone for a contribution or asking someone to ask others for a contribution. The skills used are often interchangeable.

Part of recruiting and training fundraisers is understanding that grassroots support plays a critical role in the life of most organizations through:

- providing a major source of unrestricted funds (important for advocacy work or indirect expenses that may not be an appropriate or allowable component of a grant or contract "deliverable")
- building the base of support for the organization and program
- developing ownership of program and leadership skills among volunteers

In addition, successful fundraisers learn to articulate the organization's objectives and the resources needed to achieve them in a variety of ways. Some people are attracted to the micro, tangible needs such as monitoring equipment, publications, slide shows, postage, printing, salaries, etc. Others are more interested in the "big picture," and are motivated by ideas. When I was a canvasser and we talked about monies needed to fulfill the *mission* of the organization, we called it the "concept rap." A good group training exercise is to ask committee members and all volunteer fundraisers to briefly list responses to the question *Why is the money I'm asking for important?*

Some fundraising activities, like phone-a-thons and canvasses, lend themselves to group training sessions since the volunteers are fundraising together or at least assembling together. Others, like selling tickets or ads, are more individualized. If at all possible, schedule at least one time when all fundraisers can meet for an hour or two to go through a brief training session. Obviously, certain training issues will vary depending on the type of fundraising you are doing. But some

Note: This talk is based in part on Abby Markowitz's article "Ask (Skillfully) and You Will Receive" in the Fall 1993 issue of The Volunteer Monitor *newsletter. The newsletter article provides additional ideas about grassroots and other types of fundraising. To obtain a copy, send a self-addressed envelope with 75¢ postage to The Volunteer Monitor, 1318 Masonic Ave., San Francisco, CA 94117. (Be sure to specify that you want the Fall 1993 issue.)*

Table 1. Pros and cons of common types of grassroots fundraising campaigns

Type of Campaign	Some Pros	Some Cons
Door-to-Door Canvass *(contributions usually between $10 and $50)*	• canvassers can raise over $100 in an evening or afternoon • direct contact w/community—can be a great education tool • volunteers can work in their own neighborhoods • funds are available immediately • very low costs for printing, postage, etc.	• requires a good deal of training • often difficult to get people to volunteer to go door knocking • safety issues • legal issues in some states, i.e., may need permits, etc.
Phone-A-Thon *(pledges usually between $20 and $100 each)*	• far more lucrative than direct mail solicitations—phone-a-thons can generate thousands of dollars in 3-4 nights of phoning. • phoners, without too much training, can generally raise $125-250 in pledges per session • good tool for building comfort levels, confidence, and skill among volunteers • can phone from organization's mailing list—i.e., people who have connection to organization • volunteers can all work in one place—often less stressful than isolated asking	• pledge return rate variable (50% is considered very good) • significant outlay for postage, printing • labor intensive follow-up—reminders for pledges, etc.
Adbook (or newsletter w/advertisements) *(usually $50-$500/ad depending on size)*	• adbook can serve as communication and PR tool—such as an annual report • supporters get something tangible for their contribution—ad space • builds relationship with business community • relatively large donations • some volunteers have easier time selling ads than asking directly for a contribution—can go to businesses they patronize • with a newsletter, ads can eventually pay for printing and postage of newsletter on a permanent basis	• longer-term project—generally 4-5 months from first solicitation to printing • labor-intensive, direct follow-up required • skills in layout required • adbooks can be costly to print, unless printing exchanged or discounted for ad space. Can also be costly to distribute (and advertisers want to see book as widely distributed as possible) • adbook may only net $2,000-$4,000 in first and second year • newsletter w/ads requires ongoing solicitation and follow-up
House Parties, Cocktail Parties, "Corporate Breakfasts" *(usually $25-$500 per contribution)*	• volunteers can hold house parties and invite friends, colleagues • house parties can be done for little cost—coffee, tea, snacks • receptions and "breakfasts" attract larger donors—builds relationships with business community	• labor-intensive recruitment and follow-up • parties can be expensive—hiring a caterer, renting a facility, etc. • often requires formal presentations

continued on next page

Table 1, cont'd.

Type of Campaign	Some Pros	Some Cons
Holiday Solicitations—"Give the gift of clean water for the holidays" *(usually $20-$50 per gift, depending on yearly membership dues)*	• easier to ask people to give a membership to folks on their holiday list—removes some of the commercialism of Christmas, etc. • contributors may make more than one donation—give several "gifts" • can be done through a combination of mail, phone and one-on-one contact—through the workplace, etc. • can greatly increase membership base—every "gift" adds another potential volunteer, supporter, and membership renewal	• limited to certain time of the year—must be timed correctly • will require especially efficient follow-up—people will need to give their "gifts" by a certain date • may need to have some sort of merchandise—mugs, T-shirts—to give to recipients
Benefits/Concerts *(usually $10-$20/ticket plus sales of food, beverages, T-shirts, etc.)*	• great for PR and media coverage—can get sponsorship of local radio or TV station • involves volunteers and supporters in fun project—also provides a social occasion for volunteers • can get vendors involved—charge per table or booth rented • great committee project for volunteers	• labor-intensive—requires several months of planning and time in getting donations of food, beverages, entertainment, venue, etc. • potentially large initial outlay in printing, postage, rent, food, etc. • will require entertainment • may only net $2,000-$4,000 in first year—sometimes only break even in first year

are pretty universal and should always be addressed:

• **Anticipate, acknowledge, and intercept fear.** Almost everyone is wary—or even downright afraid—of asking people for money. Don't try to minimize or gloss over people's concerns. Every training should include a discussion of fears. A good way to address this is to ask everyone to say one thing they are afraid of. Keep a running list on newsprint or a blackboard. This activity goes a long way toward breaking the ice and relieving tension. The trainer should begin in order get things going. Most likely, the majority of things listed will relate to *rejection* in some form. After the list is complete, discuss concrete ways of dealing with objections or potential objections that fundraisers may encounter. If there are volunteers present who have fundraised before, make sure they have the opportunity to offer tips and share some of their own experiences in dealing with objections or handling situations.

Probably the most important thing you can say during the course of any training is "'No' is not the end of the world." If someone won't make a contribution or buy a ticket or an ad, it doesn't mean the fundraiser is a terrible person. Also, if someone says no, that doesn't mean they will be rude or nasty. This may seem obvious, but saying it works wonders in putting people at ease.

• **Know your "turf" and your audience.** Teach your volunteers ways that they can gauge the level of support of the people they are asking. If fundraisers are targeting a specific population (a neighborhood, co-workers, friends, local businesses, organizational members or supporters, etc.) try to determine what types of information will interest them. What will motivate them to give—tangibles, or concepts? Is this person from a high-, middle-, or low-income community? Do they live in a waterfront community or one that has had specific water quality problems? Does your organization's monitoring program sample water in this community?

The answers to these questions will help the fundraiser decide what points to highlight and what amount to ask for. If the fundraiser personally knows the potential supporters, this task is relatively easy. If members of the target audience are not personally familiar, the fundraiser needs to "read" each individual. Asking questions such as "Are you familiar with this program?" and "Are you aware of any local water quality problems?" will help gauge a prospective donor's level of support. Emphasize the need to engage in dialogue, not monologue and to make, and maintain, direct eye contact (unless you are asking over the phone).

• **Keep It Short and Simple ("KISS").** Teach fundraisers to have, like Emily Dickinson's poetry, "an economy of

language." "Asks" should be brief and concise: WHO (we are), WHAT (we want—contribution, ad, membership, etc.), WHAT (the organization does—in 100 words or less, mentioning one or two successes), and WHY (it is important to give). Provide fundraisers with a short script or "rap" as a guide, but emphasize that they should not memorize it. The written script should be no more than one side of a page and should outline a couple of program successes that the fundraisers can emphasize when they talk to people.

• **Give people a reason to give.** The fundraisers are promoting both an idea and a product. The idea is the importance of achieving the organization's goals. The product is a successful program with positive results. Make sure that your fundraisers can tell people what their support will do and that they can *be specific*. For example: "A $50 donation will pay for equipment maintenance for an entire year." Provide fundraisers with a "shopping list" of what different support levels will enable the organization to do.

• **Avoid qualifiers like "try" and "maybe."** A common mistake new fundraisers make is using qualifiers that weaken the "rap." You aren't "trying" to make a difference in water quality—you ARE making a difference. People aren't "maybe" helping out with a contribution, ad, etc.—they ARE SUPPORTING THIS WORK WITH A DONATION. If the fundraiser is not confident, don't expect the prospect to be supportive.

• **Ask more than once, but listen for three Nos.** Talk about the nuances of Nos. Instruct volunteers to watch/listen for three objections, then politely end the discussion. A no can be disguised in a number of ways: not a good time to talk (response: When might be a better time?), don't have my checkbook (response: Can we set up a time for me to follow up?), unemployed (response: Folks on a fixed income are supporting us with a smaller amount), not familiar with organization (response: Neither was I; can I take a minute to tell you more about the work we do?). It is important to reassure volunteers that they have control—they can always end the discussion. You'd be surprised how many people think they have to keep talking no matter what.

• **Ask for a specific amount.** If you don't name a specific amount, you are likely to get $5 or $10. Also remember that it is easier to go down than to come up. For example, if you ask for $25 and the person says, "Sure, no problem," you can't really say, "Well, in that case, can you make it $50?" However, if you ask for $50, and the person says, "I can't afford that," you can say, "Folks that can't afford that are shooting for $25 for the year." One of the hardest—but most important—things to teach fundraisers is, *Wait for a response before coming down.* Sometimes our fear of asking tells us to immediately come down before the person has a chance to respond.

Lastly, volunteer fundraisers need to understand that their commitment is the strongest "selling point" the organization has. When engaged in fundraising, volunteers should always talk about why they themselves are involved in this work. Only someone who really believed in the organization would volunteer to go around asking people for money. Volunteers should be encouraged to use the terms "we" and "us" when referring to the organization and to always incorporate their own volunteer experiences as specific examples of the organization's work.

Committing to Diversity, Part Two: Success Stories

Moderator: **Wenley Ferguson,** Rhode Island Save the Bay
Presenters: **Bill Stapp,** GREEN; **Cliff Jones,** Technical Assistance for Community Services; **Jane Hardy,** Chautauqua Northwest

Dr. William B. Stapp
Global Rivers Environmental Education Network (GREEN)

Project GREEN Success Stories

Two of the more interesting success stories that I have been personally involved with over the past few years were GREEN (Global Rivers Environmental Education Network) projects with Walpole First Nation People in Canada and Arab-Israeli and Jewish-Israeli students in the Na'aman River Program in Israel. Before I describe those programs in detail, let me briefly outline the basic GREEN approach.

GREEN programs throughout North America and the global community introduce students to water monitoring as part of a hands-on, action-oriented approach to solving environmental problems. Computer networking links participating schools across the U.S. and around the world. Program goals include:

- Students become empowered to help protect their local water resources.
- Students learn about both natural science (ecological cycles, food chains, water chemistry, aquatic biology, and the interaction of land use and water quality) and social science (the geography of the watershed, the history of land and water use in the area, the economics of the local use of natural resources, and the government processes involved in managing natural resources).
- Students develop interpersonal, communication, and problem-solving skills by working in teams to test the water, interpret the results, identify problems, and search for solutions.

The Walpole First Nation People

The Walpole Island First Nation Reserve is in Southeastern Ontario, located on a freshwater delta at the mouth of the St. Clair River. Totaling 58,000 acres, Walpole Island contains a rich mosaic of ecosystems.

Walpole Island has been inhabited by native peoples for more than 10,000 years. Today, Walpole Island First Nation is governed by an elected Chief and 12 Councilors. Its population of approximately 2,200 Ojibwa, Ottawa, and Potawatomi people have joined together in a political and cultural confederacy called the Council of Three Fires. Although Walpole Island First Nation has had much contact with surrounding communities, its members have retained an Indian identity at the level of their deepest values and ways of living.

Relationship to the environment

Through the years the bands have practiced careful stewardship of the land. To Walpole Island First Nation, "the land" includes not only dry land, but air, water, plants, animals, humans, and a corresponding responsibility to protect these elements. For Ojibwa, Ottawa, and Potawatomi, the land has social, cultural, and spiritual significance, as well as economic importance. The people of Walpole have a very close relationship with the land, and they have traditionally relied to a significant extent on local resources. The health of the Walpole community and culture is therefore closely tied to the health of the local environment.

The band has defined sustainable development as "the process of equitable economic, social, cultural, and technological betterment in a way that does not pollute ecosystems and irrevocably deplete resources." A guiding concept for Walpole Island First Nation is that the land and its resources are to be preserved for the benefit of past, present, and future generations.

Program background

In May 1992 a student in the Black River Water Quality Monitoring Program (in Michigan) went to Walpole Island to personally invite the Walpole Community to attend the Black River Student Congress. During the Student Congress, members from Walpole Island participated fully in student and community presentations, took extra time to learn how to monitor for water quality, and participated in computer training sessions. In exchange, Walpole representatives provided the opportunity for students at the Black River Congress to attend the Annual Indian Ceremonial Celebration on Walpole Island.

In the fall of 1992, GREEN contacted Dean Jacobs, Director of the Walpole Island Heritage Centre and member of the Ontario Round Table on Environment and Economy, to determine their interest in involving their Walpole Island School in a water quality educational program. The mission of the Heritage Centre is to preserve, interpret, and promote the natural and cultural heritage of the Walpole Island First Nation Community. GREEN was asked to provide a presentation on the purpose and structure of a water quality monitoring program to the Chief, members of the Council, elders, residents, students and teachers, and members of the Walpole Island Heritage Centre.

Following this workshop, the staff of the Walpole Island Heritage Centre informed GREEN that they would be interested in involving their community in a school-wide water quality monitoring program. The program was developed in cooperation with the Walpole First Nation People and incorporated the basic components of GREEN projects throughout the world. During the second year the program expanded its computer telecommunication linkage to include indigenous and non-indigenous schools throughout the Great Lakes region and elsewhere in Canada and the United States. Responding to local concerns and to the water quality data gathered in the first year, the program also began to focus its attention on heavy metal monitoring.

The Na'aman River Program in Israel

GREEN and the Nature Reserve Authority (NRA) of Israel embarked on a new project in November 1993. This program was designed to bring together Jewish and Arab Israeli students within the same watershed to work cooperatively to improve the quality and quantity of their water and their cultural relationship.

The first phase of the program established a common water monitoring program, involving 15 secondary school classes from both Arab and Jewish schools in the watershed of the Na'aman River, north of Haifa, Israel. The second phase was designed to improve critical water issues on the Na'aman River.

The Nature Reserve Authority is a governmental organization that manages the entire nature reserve system of Israel (approximately 400 reserves). Seven guiding centers located in specific reserves are currently in operation, each one responsible for a specific region, such as the En Afeq Guiding Center in western Galilee.

The En Afeq Center, located in an 800-year-old Crusader watermill, provides field activities for classes of all ages. Students enjoying the Center include local schools with Moslem, Druse, Greek Orthodox, and Jewish populations. The En Afeq GREEN Program provides the opportunity for students from both Arab and Jewish high schools to monitor the waters of the Na'aman River, resulting in the establishment of database information and watershed management and protection strategies. This cooperative effort is enhanced by working in English, the second language common to both groups.

Environmental protection and wise use of natural resources are critical in every corner of the world. In the Middle East, the scarcity of water resources, increased pollution, and depletion of available water are leading to a grave water crisis that must be addressed by all citizens, regardless of ethnic, religious, or cultural group. Citizen effort to protect and conserve precious water at the local level is a critical element of any water management strategy.

Educating students about water quality and quantity and involving them in relevant problem-solving strategies are excellent steps toward achieving this goal. In addition, such local efforts require cooperation between the diverse cultural and religious groups that share water resources. A program that brings students from such groups together to address a mutual problem provides a foundation for continued cooperation in the future.

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Cliff Jones

Technical Assistance for Community Services

Tools for Diversity

There are three key ongoing functions that organizations need to do to successfully address exclusion. (Note that we are talking here not about exclusion of people based on philosophical differences but on oppression—i.e., racism, sexism, ageism, socioeconomic class oppression.)

1. **Make a collective decision.** If you want to include people who have been excluded, you need to make a collective decision to do so. Otherwise, organizationally, one foot will be moving forward while the other is moving backward.

2. **Collect information.** Do a self-assessment of your organization. Who is excluded, and how and why are they excluded? How does your organization relate to the excluded community or group? How competent are you as an organization to deal with other communities and groups?

3. **Take action.** You need to have some goals and a plan so that you continue to move forward.

The following are six key strategies that have worked in helping organizations address these issues of exclusion:

1. **Set up a diversity committee.** The purpose of the committee is to think collectively about inclusion, to institutionalize the process. The committee will undertake ongoing thinking, planning, and action-taking regarding organizational change, and will bring together strategic sectors of the organization necessary to achieve desired change.

2. **Conduct diversity training.** There's no sense in bringing diverse people in if members of the organization don't know how to interact with them and are not struggling to communicate and reach out. The diversity training will educate the organization regarding institutional and personal bias and will facilitate information gathering, action taking, and problem solving.

3. Set up a multicultural advisory group. This is a way of bringing voices to the table that have not been at the table. The multicultural advisory group should not be assigned to work only on "minority issues" but should have input into the organization as a whole.

4. Alliance-based problem solving. Functioning from an alliance-based problem-solving perspective means moving away from being "one-up/one-down" to being "different but equal." Alliance-based problem solving seeks real solutions that address the structural inequality inherent in oppressive models. If we have privilege, involving other groups is not about "helping" them; we are helping ourselves. We will gain creative solutions that we haven't been able to think of because of our limited experience.

5. Ongoing organizational goals. Make sure the organization always has an agenda of inclusion.

6. Policy review/changing and interrupting institutionalized oppression and prejudice. If you really want to include people, you need to look at how your organizational policies may be excluding people. It may have to do with how people get promoted to leadership or how people get access to resources for training. Do the men control, do the white people control, do the urban people control? Then you need to interrupt these exclusionary policies.

Question-and-answer session

The remainder of Cliff Jones' presentation consisted of a question-and-answer session with workshop participants.

Question: How can our group work with indigenous people to encourage them to extract resources in environmentally sound ways?

CJ: The first thing that pops into my mind is acknowledging a history of oppression—acknowledging that those practices probably would work if those folks had had control of the resources. It seems unfair: They haven't had power over the resources, and now, because of what other people have done, they are being asked to change, and their livelihood is being threatened. Often people think that history is irrelevant. But if you can come to the table showing a full and deep respect for why the situation is the way it is, people will be more willing to problem-solve.

I would suggest going to the table and listening for a long time before you make any suggestions. Follow the model of alliance-based problem solving; work on the problem from the vantage point of "different but equal."

Question: We were given money to conduct training for tribal groups. I'm an ex-Peace Corps volunteer, and I know that you can't help people without a request for assistance, but I'm now caught in this position of offering a service when they haven't requested it.

CJ: This sounds like institutionalized racism to me—"We're going to help these people." The risk to your group is that you will be seen as patronizing. My first suggestion is, if it's possible, turn over that money to the tribal groups to do whatever they want with.

Question: We have the same problem. We got a huge grant to work in the inner city, but it has to be used to plant trees.

CJ: I believe there's a way to get the trees planted and to do it in a way that people become advocates. Maybe it means spending more of the money that the grantors wanted to spend on figuring out how to involve community people. Give people in the community the power to make decisions. They will come up with some new ways.

Question: What can you do if you have groups of people of color that are conflicting with each other?

CJ: People of color have learned the same stereotypes about their group and other groups as everyone else has learned, and we've been pitted against each other to some extent. You can help if you can function as an ally to both groups. You can mediate, problem solve, be rational. You can hold out to both groups complete alliance and complete reality about their goodness, about their rights to participate, and about their ability to cooperate.

Jane V. L. Hardy
Chautauqua Northwest

Senior Participation in Environmental Monitoring

My assignment today is to discuss the possibilities and pitfalls of senior participation in environmental monitoring, based on our own operating experience. In theatrical terms, we have known a combination of high drama and low comedy, and even tinges of tragedy in the form of lost potential. To set the stage, let me sketch the players and the play.

Project background

In November 1989, Chautauqua Northwest created "Seniors for the Sound." This was America's first retiree-based volunteer program for environmental service. Chautauqua Northwest is a nonprofit partnership of business and seniors which promotes innovation and leadership in aging through civic projects, research, and mature market consulting. Our environmental project was initiated in cooperation with the Puget Sound Water Quality Authority, a Washington State agency responsible for the cleanup and protection of Puget Sound. This major estuary, shared by Washington and British Columbia, is comparable to the Chesapeake Bay for environmental and economic significance.

For four years, as "Seniors for the Sound," our trained retired volunteers helped state scientists and planners meet

legal mandates for environmental monitoring. Seniors sampled shellfish for chemical and bacteriological testing, monitored fish runs, mapped water permits by computer, and designed educational surveys. Altogether, 44 individuals logged a combined 2,390 hours of volunteer service. The cost savings due to their efforts were significant.

The first step in mobilizing seniors for environmental service is peer-based environmental education. This is the current focus of our project, now named "Seniors for the Environment" to reflect broader environmental interests. With mini-grants from King County Surface Water Management Division and EPA Region 10 and technical support from BIOMED and UNICO Properties, Inc., our older volunteers have developed a traveling display and presentation to take to senior audiences regionwide. The goal is to recruit new retired volunteers for public or private environmental agencies working in such areas as water quality testing, gardening and recycling plants, protecting fish and shellfish, and restoring streams and wetlands. The theme is, "What can one person do?" The answer, "PLENTY!" With that in mind, I would like to turn to the questions posed to the panel. These are: (1) What were your successes? (2) What obstacles or failures did you experience? (3) What lessons were learned?

Project successes

Originally, the Puget Sound Water Quality Authority approached Chautauqua Northwest to start a senior environmental service program because of our reputation as a "can do" civic organization for retired people. The idea was to create a senior "strike force" that would be on call to do legwork and provide support services to state and certain EPA regional staff. Our trained retired volunteers would be prepared to go anywhere, do anything to assist professional staff of the Authority and related state agencies in their work to clean up and protect Puget Sound. Our team was first nicknamed "The Anti-Dirty Dozen" and was even featured on CNN.

Our great success and source of pride is that we completed every single assignment except one. In that case, a park ranger denied volunteers access to a state beach for shellfish sampling due to gale force winds. Also, we repeated two assignments when the Public Health Laboratory accidentally destroyed the first samples.

Obstacles or failures

Ageism—without question—has been the greatest obstacle to success in our senior environmental project. Our project volunteers were healthy, active men and women aged 60- or 70-something. Most were retired business or professional people who enjoyed outdoor recreation and/or owned vacation property.

Even so, as project manager, I will never forget the call I got from the state staff person who was escorting our volunteer team to their first moonlight clam dig in late November. He called from a phone booth out on Interstate 5 just to go on record that he was not going to be personally responsible for—and this is a direct quote—"a bunch of goddammed elderly people out on the beach at night." It was pretty clear to him that the ones who did not have heart attacks would just die of hypothermia!

Of course, none of that happened. But the fact that they all went, did a good job, and had a good time did not really erase the underlying attitude. Ageism is based on persistent negative stereotypes. Our volunteers, now all great chums of this fellow, were seen as exceptions to the rule. But no one questioned the validity of that devastatingly negative "rule."

Granted, this was an extreme example. But ageist attitudes among some other professional staff ranged from patronizing to overly solicitous to sarcastic or contemptuous. Ironically, both state staff and retired volunteers saw themselves as helping the other out. Senior volunteers thought they were generously helping environmental staff do a better job. Environmental staff thought they were kindly giving the old folks something to do. What's wrong with this picture?

Naively, I thought the solution to the attitudinal problem was outstanding performance. I thought if we were just well-organized, brought a wealth of project management experience to bear, and did an excellent job, the environmental agency staff would appreciate our work and see our senior team as a real asset. Wrong.

Any time a volunteer group can step in, analyze a task, and perform it as well as, or better than, the paid professionals for a fraction of the cost, they are not an asset; they are a threat. Again, what's wrong with this picture?

Lessons learned

Chautauqua Northwest is not an "environmental organization" per se. But that is not to say we do not care about our natural heritage. Older people care deeply about the natural legacy they will leave their children, and especially their grandchildren. That caring can and should be translated into constructive, extensive environmental service.

Looking across America, we see that retired people represent a tremendous, underutilized resource for meeting national goals to protect, restore, and enhance our natural environment. Older people are an increasingly potent force in American life. People age 55+ comprise nearly one-fourth of the total population, one-third of the eligible voters, and one-half of the actual voters. Consequently, any effort to create popular consensus on environmental matters simply must involve older citizens. Investing environmental education and program dollars in children is great . . . for a long-term payoff. But investing in older people who have no time to waste can generate more immediate benefits.

In my view, the lesson to be learned from our experience in "Seniors for the Environment" is to try harder. Older volunteers can and should be integrated into serious environmental protection and enhancement work across the nation. It would be a fundamental mistake to let stereotypes block their way.

Building Partnerships with State Governments

Moderator: **Robbi Savage,** Association of State & Interstate Water Pollution Control Administrators
Presenters: **Ken Cooke,** Kentucky Water Watch; **Italo Carcich,** NY Dept. of Environmental Conservation; **Richard Kepler,*** Oregon DEQ, Groundwater Section; **Eric Mendelman,*** Texas Watch; **Mr. Lynn Singleton,** DOE Environmental Investigations and Laboratory Services

Ken Cooke
Kentucky Water Watch

Tips on Working with State Agencies

In any agency you're going to find three basic types of people: good people, bad people, and just people (see figure at right). The point is that when volunteer monitoring groups approach a state agency, we have to speak a bit of their language. You may want a clean stream that you can fish and swim in, but the agency will translate that into some sort of wastewater allocation formula.

It's not hard to learn some of their language; just read a few of their reports. And recognize that no matter what you say or do, some people in the agency still won't agree with you. You need to identify who your friends are.

Agency job classifications

Now let's look at some of the different job classifications you may be dealing with at a state agency: political appointees, supervisory managers, administrative staff, technical staff, common laborers, field staff. Each category has something to offer you, and each has certain needs and wants that you should bear in mind when working with them.

I've always found that **political appointees** are really good at getting the ball rolling, setting the tone, providing the authorization. In our state it was a political appointee who said, "I want a citizen component." What political appointees need is good press and low-cost options that imply *action.*

Then come the people who actually implement programs: the **supervisory managers.** These people will assign staff and resources to the program. They usually need to know, How much is this going to cost? How much of my staff's time is this going to take? and Who do we hang if it explodes? Usually volunteer monitoring groups have to do some "selling" at this level.

You'll be dealing with the **administrative staff** if you have a financial relationship with the agency. They are skilled at getting the bills paid, taking care of printing and mailing, etc. What they need is for you to fill out Form 70DQA-4 and provide all the proper account information.

Types of people you will encounter in a typical state agency		
GOOD people	**BAD people**	**Just people**
People who think like I do	People who don't think like I do	People who don't think at all

The **technical staff** are usually the people with whom we will interface the most. They will be working with us in the field, helping with program design, training, etc. One thing they need is to be assured of their technical superiority. Some of our technical staff were threatened by the monitoring project—they were afraid that we would take away their jobs or their funding. It's also important not to overload the technical staff.

Common agency activities

When you set up a relationship with a state agency, find out exactly what projects they are doing so you can figure out where you fit in. Some activities that most state water agencies are involved in are:

- ambient monitoring
- stream use designations
- 319 assessments
- NPDES permitting
- field inspections
- technical assistance
- 205-208 infrastructure planning
- enforcement
- water quantity/resources management
- dam safety
- public participation requirements
- planning

Finding common ground

When we started our program, we conducted a survey of both volunteers and agency staff. We asked volunteers what they wanted to do, and we asked the agency staff what they wanted done. We then identified the "common ground" where the two lists meshed. We found that volunteers did not want to stuff envelopes or do data entry. Our agency staff did not want volunteers initiating enforcement cases, and they didn't want them to do stream use designation assessments because that involved collecting a complicated set of data. (In fact, how-

*No paper submitted

ever, some of the data our volunteers collect do go into stream use designation assessments.)

Fortunately, we did find many areas of overlap. Volunteer activities that were accepted by both groups included:

- 319 stream assessments
- background monitoring
- compliance monitoring
- streamside trash cleanups
- serving on advisory groups

Contract with volunteers

We set up an informal contract with our volunteers. The contract spells out the program's goals, each side's responsibilities and expectations, and what kind of support volunteers can expect.

It's important to incorporate a "bail-out option" in the contract. How many of you have had volunteers who work really hard for a year, then drop out—and feel so guilty that the next time they see you they look at you as if you're a bill collector? You want to make sure they can retire with accolades. Let them know that after a year, they are free to move on.

Italo G. Carcich, P.E.

New York State Department of Environmental Conservation

Agency-Citizen Partnerships in New York State

New York State contains more than 7,000 lakes, ponds, and reservoirs, and countless miles of streams and rivers. The public has expressed a great desire to expand the recreational opportunities afforded by these natural resources. However, the large number of lakes and ponds and the many miles of rivers and streams present the state of New York with difficult management problems.

Agency/citizen partnerships

How can these management problems be solved? The only alternative identified early in our efforts was the creation of a partnership with the citizens of the state. The best way to describe this partnership is to identify the types of activities that have been undertaken.

The Division of Water publishes a Water Bulletin and actively promotes "Water Week." We initiated a highly successful Citizen Statewide Lake Assessment Program. Together with the Federation of Lake Associations of New York we published *Diet for a Small Lake: A New Yorker's Guide to Lake Management.* And, most importantly, we have made public participation a high priority in all of our programs.

The Division of Water's involvement with the Federation of Lake Associations of New York is key to our success. The Federation, which consists of lake associations, government and academic professionals, corporations, environmental groups, and individual citizens, serves as a clearinghouse for disseminating information, providing technical advice, and promoting citizen action to preserve, protect, and restore the surface waters of New York.

Likewise, we have been very active with the County Water Quality Coordinating Committees. A number of agencies, such as the Soil Conservation Service, the Cooperative Extension Program, and the Environmental Management Committee, are all working with lake associations, local organizations, and private citizens in order to develop environmental strategies. Working together we identify and set local priorities to prevent nonpoint source pollution and increase interagency cooperation.

The Division of Water is also building a water stewardship program with over 225 groups and individuals of all ages across the state. It is a campaign to spur voluntary action at the local level and to recognize achievements. Recruitment is accomplished by distributing stewardship brochures and Water Week packets to schools, conferences, fairs, and local offices. Groups adopt water bodies or streams and these are added to the database of the state. Also, groups conduct action projects, such as cleanups, testing, lobbying, etc., with our assistance. We recognize their achievements and present certificates to them during Water Week (first full week in May).

CSLAP

One of our strongest partnerships is our Citizen Statewide Lake Assessment Program (CSLAP), started in 1986. We now have close to 500 volunteers who are fully instructed in the collection and interpretation of reliable water quality data, lake ecology, and best management practices.

When CSLAP started, the State of New York was the sole funder. Now we have built an even greater partnership by having federal and county governments and lake associations become partners with the state in funding this program.

Uses of CSLAP data

CSLAP depends on the gathering of reliable data. We place special emphasis on quality control/quality assurance. Because we have demonstrated the accuracy of the data set generated by CSLAP, it is being used to assess lake status, determine long-term trends, calibrate water quality models, and develop eutrophication standards. The water quality data can be used to characterize the lake by establishing the trophic status, water hardness, acidity status, and limiting nutrient. The data can also determine the critical factors that are affecting the use of the lake, and can provide an indication of temporal changes over the period of data collection (weekly, seasonally, annually, or multi-year).

Of particular importance in this partnership is the fact that the data are used to develop lake management plans. The water quality data set serves as the cornerstone for all of our lake management plans. This in turn allows the individual lake association to develop lake management objectives and

to identify the important user groups and critical users. Volunteer data can identify problems and provide tools for proper problem diagnosis. The monitoring data can link symptoms to the causes and in turn to the sources of the problems.

The volunteer data can also serve as the basis for further studies. The data may indicate the need to explore other media than just the water column (such as sediments, fish, etc.) or to investigate sources of pollution beyond the boundaries of the lake (e.g., tributaries or the surrounding watershed).

Even after the lake management plans are completed, there will be a continuing need to collect volunteer data to evaluate the impacts of management activities. Together, the state and the citizens can determine the effectiveness of nutrient abatement strategies through the continuation of in-lake measurements.

As can be seen, not only has CSLAP provided the basis for building a lasting partnership between the state and its citizens, but also we are now further expanding the initial concept and building a stewardship program that will allow an even greater participation by citizens. CSLAP opened the way for these new initiatives.

Mr. Lynn R. Singleton
Washington State Department of Ecology

Volunteer Monitoring Partnerships: Some Agency Considerations

There are a number of volunteer monitoring efforts going on in Washington, conducted by many different agencies for several purposes. The Department of Ecology has had a Citizen's Lake Monitoring Program for five years now. It has resulted from citizen efforts and state and federal funding.

Our modest program has been successful for a number of reasons and I would like to expand our volunteer efforts. I'm in favor of volunteer monitoring, but I think it's important to take steps to be sure these programs work and are successful. Here are some of the things that I, as a manager, would want to consider in setting up a volunteer monitoring program:

- Identify a need that can be met by a volunteer program.
- What type of volunteer is needed—adults, students, post-secondary, elementary, all groups? This will affect how the program is structured.
- Local versus statewide. Most often I would be looking at a state program. This can involve logistical issues—for example, will I have to train a volunteer who is 300 miles away?
- Short-term vs. sustained efforts. Long-term efforts take a different kind of institutional support and maintenance. This is not meant to diminish the tasks involved in short-term efforts. Success happens or not over the long haul.

A few words about volunteers in relation to long-term efforts:

- Ask yourself why volunteers are there—what is motivating them?
- Their time is as valuable as yours and mine, and it should not be wasted.
- Volunteer time can't be viewed as free by an agency. An agency must provide essential care and feeding for volunteers, just as it would for employees, if a program is to be successful.
- Like employees, volunteers need to be able to access the organizational structure. They need to know who to call with questions. Some are motivated by the access.
- Initial and ongoing training are required.
- Ongoing technical support is needed.
- The project needs to be valued; the data can, and will, be used.
- Volunteers need to understand how the data can be used—"expectation management."
- Volunteers need to know their efforts are appreciated in some way.
- Data management needs to be ready to receive information before the project begins.
- The QA/QC requirements need to be understood by all at the onset.
- Summarization, interpretation, and reporting methods need to be established prior to the program initiation data.
- Volunteers like to have feedback.

Benefits to state agency

Some of the benefits a state agency receives from working with volunteers are:

- Credibility—involved community, better understanding and implementation of programs.
- Public can be more politically and technically astute.
- Useful data can be obtained at a lesser cost to assist decision makers.
- Agencies can better understand local values and priorities. The volunteers also understand the agency better.

Costs

- There are several infrastructural costs.
- There is a cost if volunteers' expectations are not met.
- Volunteers can become alienated when a positive situation turns into something else.
- Critics of volunteer efforts may have their doubts confirmed. This can set other efforts back.

Problems we face in agencies

- More work than can be done.
- Regulatory/resource agencies are under fire in harder economic times.
- Limited budgets to get work done.

- Many programs have significant backlogs and areas where data are not available.
- Data management, consistency, and QA are issues we face among agencies. These problems aren't unique to volunteer data. Some agencies don't use each other's data.
- If we start a volunteer program, we need to be committed to it. It is difficult in harder economic times.
- Regulatory issues and uncertainties of data use.

Future

I am looking to the future for some of the new initiatives that stress local involvement and collaborative participation to allow resource pooling—i.e., watershed approach, basin management efforts.

Managers must realize that there is more than one way to get to an end. There is more than one way to collect data. We can't continue doing business in the same way. The saying that "we are from the government and we're here to help" doesn't play well. Local implementation is where it is really at.

Citizen involvement will pay dividends, once the start-up needs are met. I look forward to expanding our citizen efforts in the future.

Bacteria Testing, Part One

Moderator: **Esperanza Stancioff,** University of Maine Cooperative Extension
Presenters: **Esperanza Stancioff; Sigrid Schwind,** Oregon DEQ; **Geoff Dates,** River Watch Network

Esperanza Stancioff
University of Maine Cooperative Extension

Basic Concepts and Definitions

Pathogens

In monitoring for bacteria in Maine, what we are concerned with are microbial pathogens, especially in shellfish-growing waters. The pathogens are the "bad guys"—i.e., those that are capable of causing disease.

Some of these bad guys are:

Bacteria	Viruses	Protozoa
Salmonella typhi	hepatitis	*Giardia*
Legionella	Norwalk virus	*Cryptosporidium*
Shigella	polio virus	
Vibrio cholerae		
Vibrio vulnificus		

What are bacteria? They are microscopic single-celled organisms that multiply by binary fission. They are 2 - 4 μ in size, ubiquitous in nature, and may be either beneficial or pathogenic. Over 5 million could fit on the head of a pin.

What are viruses? Viruses contain only one type of nucleic acid (DNA or RNA), are inactive when outside of a living host cell, and are all parasitic. They have protein coats that provide protection. They range in size from 0.02 to 0.09 μ.

What are protozoa? They are much larger than bacteria and viruses. They are common in bodies of water. Some species secrete a protective covering and form a resting stage (cyst).

Indicators

The problem is that we cannot readily isolate and quantify pathogens in environmental water samples. There are too many pathogens, and the methods for isolating and identifying them are too sophisticated and expensive.

The solution is to monitor for the presence of organisms that are *indicators* of sewage pollution. Requirements for good indicator organisms are that they:

- are typically present in sewage pollution
- typically survive longer in water than pathogens
- are readily detectable from environmental samples

Two commonly used indicators are total coliform and fecal coliform. The total coliforms are rod-shaped gram-negative bacteria that ferment lactose at 35°C. They are found in the intestinal tracts of cold- and warm-blooded animals. Species include *Escherichia, Klebsiella, Enterobacter, Serratia, Citrobacter,* and *Edwardsiella.*

The fecal coliforms are a subset of the total coliforms. They are present in sewage and indicate the possibility that human pathogens are present. They are distinguished from the total coliforms by their ability to ferment lactose at 44.5°C. Species include *Escherichia coli (E. coli)* and *Klebsiella.*

Methods

The two detection methods most commonly used are:

- **membrane filtration** (MF), which is a direct plating method. MF is accepted by EPA but not accepted by FDA.
- **multiple tube fermentation** or **"most probable number"** (MPN), which is a serial tube dilution. MPN is FDA-accepted but not recommended by EPA.

The basic steps in membrane filtration analysis are:

1. A 100-ml water sample is passed through a 0.45 μ filter. The bacteria are retained on the filter surface.
2. The filter is exposed to growth medium and incubated.
3. The bacteria multiply, forming visible colonies.
4. After a specific incubation time, colonies are counted and reported as colony-forming units per 100 ml (CFU/100 ml).

The basic steps in multiple tube fermentation analysis are:

1. The sample is serially diluted in liquid growth medium in tubes.
2. Tubes are incubated.
3. The bacteria multiply, forming turbid cultures with gas bubbles.
4. An estimate of bacterial numbers is made, based on end-point dilutions of growth and statistical tables. The number is reported as most probable number per 100 ml (MPN/100 ml).

Sigrid Schwind
Department of Environmental Quality, Northwest Region

Overview of Methods

A. EPA bathing beach study

EPA's bathing beach study, begun in 1972 at marine and freshwater bathing beaches, was the first good epidemiological study to try to correlate indicator organisms with incidence of gastrointestinal illness in swimmers. The results showed that in marine water enterococci correlated best with swimming-associated gastroenteritis. In fresh water, enterococci and *E. coli* both correlated well with swimming-associated gastroenteritis. (The enterococci are a subset of

the fecal streptococci, and *E. coli* is one species of the fecal coliform group.)

B. Criteria

Ambient Water Quality Criteria for Bacteria, published by EPA in 1986, lists the following criteria (based on five samples in a 30-day period and a geometric mean):

1. For fresh water:
E. coli - 126/100 ml
enterococci - 33/100 ml

2. For marine water:
enterococci - 35/100 ml

These criteria are based on "acceptable" swimming-associated gastrointestinal illness rates of 8/1,000 in fresh water and 19/1,000 in marine water. Single sample exceedence values are also given in the EPA document.

C. Water quality standards in different states

1. Five states (Maine, New Hampshire, Vermont, Indiana, and Ohio) have an *E. coli* standard for fresh water.

2. Three states (Connecticut, Hawaii, and Puerto Rico) and one Indian tribe have an enterococci standard for fresh and/or marine water.

3. Eighteen states have summer (seasonal) standards.

4. Thirty-seven states still have fecal coliform standards.

D. Methods

1. Membrane filtration methods

a. Fecal coliform (FC)
- medium = mFC agar or broth.
- incubate for 24 hrs at 44.5°C.
- colonies are medium to dark blue.

b. *E. coli*
- media = mTEC and urea substrate.
- incubate for 2 hrs at 35°C, then 22-24 hrs at 44.5°C.
- after incubation, place filters on urea-soaked pads.
- incubate 15-20 minutes at room temperature and count yellow colonies.

c. enterococcus
- media = mE and EIA.
- incubate mE for 48 hrs at 41°C; transfer to EIA and incubate for 20 min at 41°C.
- count red colonies that produce black or brown halos on the underside of the media.

2. Most Probable Number (MPN) method
- medium = Lauryl Tryptose Broth (LTB) or Lactose Broth (LB) and EC broth.
- 15 tubes (5 tubes at three dilutions).
- check LTB or LB tubes after 24 hrs at 35°C. If positive for gas and growth, transfer to EC broth. Check EC tubes for gas and growth after 24 hrs at 44.5°C.
- check LTB or LB tubes again after 48 hrs at 35°C. If positive for gas and growth, proceed as above.
- check combination of positive tubes in MPN tables in *Standard Methods*.

3. Colilert
- low-tech method used frequently in drinking water testing.
- Presence-Absence method or MPN method.
- add volume of water sample to substrate already in tubes, incubate for 24 hours and check for yellow color and fluorescence.

E. Why different agencies use different indicators and methods

1. For fresh water, EPA recommends *E. coli* and enterococcus, but FC can still be used.

2. FDA has traditionally used FC-MPN, and in many states standards for marine shellfish-growing waters are still for FC.

3. For marine waters EPA does not recommend *E. coli*, since it did not correlate well with gastrointestinal illness in swimmers for marine waters. EPA recommends enterococci for marine waters. However, FC is still being used.

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Geoff Dates
River Watch Network

Choosing an Indicator Bacteria and Analyzing Bacteria Data

I. Choosing an indicator bacteria

In the past 50 years, the most commonly tested bacterial indicators have been total coliforms, fecal coliforms, *E. coli*, fecal streptococci, and enterococci. All but *E. coli* are comprised of a number of species of bacteria that all share common characteristics such as shape, habitat, or behavior. *E. coli* is a single species of fecal coliform.

Choosing which one of these indicators to monitor is a part of the study design process.

Total coliforms
This is a group of bacteria that is widespread in nature. All members of the total coliform group may occur in human feces, but some may also be widespread in the environment, such as animal manure, soil, submerged wood, and other places outside the human body. For recreational waters, total coliforms are no longer recommended as an indicator. For drinking water, total coliforms are still the standard test since their presence indicates contamination of a water supply by an outside source.

Fecal coliform
This is a subset of total coliform bacteria which is more fecal-specific in origin. However, even this group contains a genus, *Klebsiella*, with species that are not necessarily fecal in origin. *Klebsiella* are commonly associated with textile, pulp, and paper mill wastes, in the absence of fecal contamination. Therefore, if these sources discharge to your river, you may wish to consider a more fecal and human-specific bacteria. For recreational waters, this group was the primary bacteria indicator until relatively recently when EPA began recommending *E. coli* and enterococci as better indicators of health risk from water contact. Fecal coliforms are still being used in many states as the indicator bacteria.

Escherichia coli (E. coli)
This is a particular species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. EPA recommends *E. coli* as the best indicator of health risk from water contact in recreational waters and some states have changed their water quality standards and monitoring accordingly.

Fecal streptococci
This group of bacteria generally occurs in the digestive systems of humans and other warm-blooded animals. In the past, fecal streptococci have been monitored together with fecal coliforms, and a ratio of coliforms to streptococci calculated. This was used to determine whether the contamination was of human or non-human sources. However, this is no longer recommended as a reliable test in the 20th edition of Standard Methods.

Enterococci
This is a subgroup within the fecal streptococcus group. They are distinguished by their ability to survive in saltwater, and in this respect they more closely mimic many pathogens than the other indicators. They are generally more human-specific than the larger fecal streptococcus group. EPA recommends enterococci as the best indicator of health risk in saltwater used for recreation and as a useful indicator in fresh water as well.

How to choose
There are two main considerations in choosing which indicators to monitor:

1. What question are you trying to answer?
2. How difficult, time-consuming, and expensive is the indicator to sample and analyze?

Which bacteria you test for depends on what you want to know. Bacteria are commonly used to either determine the health risk of water contact (through compliance with state water quality standards designed to protect human health) or the presence of fecal contamination from humans or animals to help determine the impact of point or nonpoint pollution sources on a river.

Studies conducted by the EPA to determine the correlation between different bacterial indicators and the occurrence of digestive system illness at swimming beaches suggest that the best indicators of health risk from recreational water contact in **fresh water** are *E. coli* and enterococci. For **saltwater,** enterococci are the best. Interestingly, fecal coliforms as a group were determined to be a poor indicator of the risk of digestive system illness. However, many states continue to use fecal coliforms as their primary health risk indicator.

Both *E. coli* and enterococci are analyzed using the membrane filtration procedure. This procedure is relatively user-friendly for properly trained volunteers. However, it is time-consuming, is not recommended for field analysis, and requires special equipment and strict quality assurance/quality control. A warning about the enterococcus test: the nutrient medium contains an extremely toxic material—nalidixic acid. Handling this material requires special precautions, such as protective clothing and a ventilation hood. For this reason, it may be a good idea to have a lab with these facilities make up the medium for you.

The bottom line
If your state is still using total or fecal coliforms as the indicator bacteria, and you want to know whether the water meets state water quality standards, use fecal coliforms. However, if you want to know the health risk from recreational water contact, the results of the EPA studies suggest that you should consider switching to the *E. coli* or enterococci method for testing fresh water. In any case, it's best to consult with the people at the water quality division of your state's environmental agency, especially if you expect them to use your data.

II. Summarizing, displaying, and analyzing the results
Lab sheets contain the raw data in the form of filter counts. These filter counts are converted to and reported as colonies per 100 ml.

The results on the lab sheets are then converted to a form that is easier to analyze. The data may be summarized in tables or in the form of various charts and graphs. This enables you to view the data as a whole.

A computer is strongly recommended for data management. Most spreadsheet programs have fairly extensive graphing capability. Trends, results that exceed a desired result, and other highlights may be apparent at this point.

The data are then displayed in a way that tells the story of

E. coli per 100 mL								
Sites	5/27/92	6/16/92	8/3/92	8/20/92	9/23/92	10/7/92	10/21/92	Geometric Mean
MoB001	200	90	770	310	7100	248	8	250
MoB013	200	2400	-	12200	10000	1800	1300	2271
MoB014	200	7500	-	13800	10000	2900	700	2737
MoB015	7	430	10000	6200	1200	600	1400	788
MoB016	200	24000	10000	2500	700	200	500	1355
MoB017	-	-	-	-	500	324	300	365

Figure 1. *Table showing* E. coli *results for the season.*

the results. Following are four examples of how bacteria results can be displayed.

Example 1: Table showing results for the season

Figure 1 (above) is an example of a table that displays the results for six sample sites on a small brook in New Hampshire. A table like this is an easy way to look at lots of results at one time. However, graphs can tell a more compelling visual story.

Example 2: Graphed results for one date

The next example shows the results for *E. coli* bacteria for one sampling date at six sites (Figure 2, above).

Sample sites are listed along the horizontal axis, upstream to downstream left to right. A range of *E. coli* values (from 0 to 1,000) is displayed on the vertical axis. Results for each site are shown by the bars. The height of the bars corresponds to the levels of bacteria found at each site. We've added a horizontal arrow which shows the NH Water Quality Standard (406 bacteria colonies per 100 ml for class B waters). Levels above the line exceed the standard and are considered a health risk for swimming. The graph shows that bacteria levels increase upstream to downstream, and that swimming at any of these sites would be a health risk.

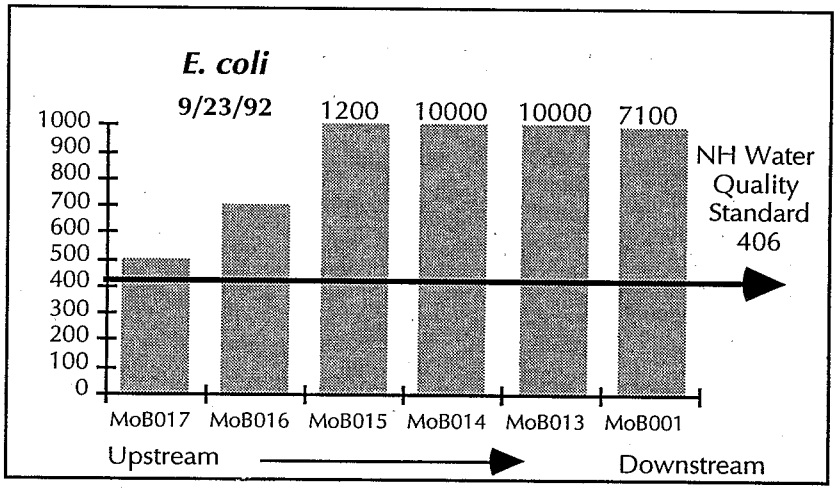

Figure 2. *Graph of results for one date at six sites.*

Example 3: Graphed results for the season

Figure 3 (below) shows the results for an entire sampling season expressed as the geometric mean of the results for the entire sampling season—six sampling events. The geometric mean is a type of average that minimizes the influence of very high and very low results on the average. (Note: Using a median is another way to accom-

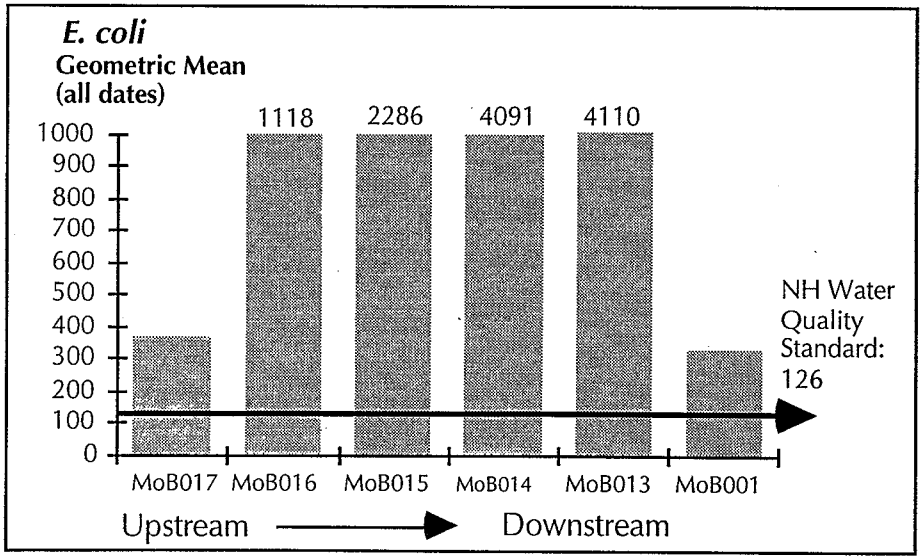

Figure 3. *Graph of results for the season.*

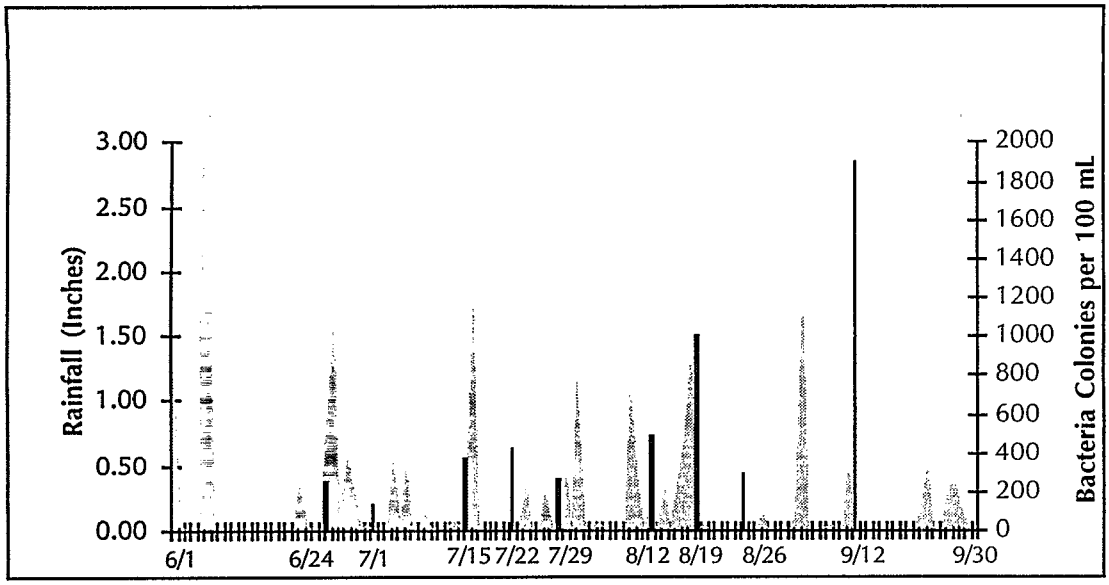

Figure 4. Graph comparing bacterial results with rainfall.

plish the same thing.)

This graph shows the same type of upstream to downstream increase, with the most downstream site showing some recovery.

Example 4: Graph comparing bacteria results with rainfall

Figure 4 (above) shows a graph comparing bacteria results (the bars) with rainfall (the shaded area) at the most downstream site on a river. Sampling dates are listed below the x-axis.

Rainfall events occurred on two of the sampling dates: 8/19 and 9/12. These dates also showed the highest bacteria levels. This response is typical of a river where surface runoff from nonpoint sources carries bacteria into the river from failing on-site septic systems or animal manure.

Analyzing the results

Many monitoring groups establish a technical committee to help them analyze the results—that is, to develop *findings* (what the data says) and *conclusions* (why you think the data says what it says). Produce a report that summarizes the activity, reports your findings and conclusions, and makes recommendations for actions to address problems or for modifications to the sampling program if needed. Some programs produce an annual "state of the river" report that summarizes and analyzes the results of the preceding year, and all previous years, highlighting trends, cleanup progress, new trouble spots, etc.

Keep your volunteers informed of the results, as often as possible. Some groups produce monthly summaries for volunteer participants or send out periodic newsletters.

Presenting Your Data to Different Audiences

Moderator: **Ivy Frances,** City of Portland Environmental Services
Presenters: **Katney Bair,** City of Portland Environmental Services; **Jana Suchy,** Tetra Tech, Inc.; **Lynn Kramer,** Herring Run Watershed Association

Katney Bair
City of Portland Environmental Services

Capturing Attention with Visual Images

Visual images and graphics are part of our lives; we can't get away from them. They influence us without our even being aware of them.

We absorb, retain, and process all sorts of unwritten, unspoken information every day. For example, when you look at a stop sign, the color conveys a warning: it's fire-engine red; it's an alarm. The sharp edges say, "This is serious"; the plain type, very bold, says, "Pay attention to this; this is something you have to obey."

Ad people are very good at what they do, and they need to be, because every day we are bombarded with images. You and your organizations have to compete with that, and you don't have Coca Cola's budget, so how are you going to get your messages heard? I'm going to talk to you about the tools that graphic designers use to create powerful messages.

Who is the audience?

The first and most important step is to determine who is your audience. Who are you talking to? Without knowing that, you can't focus your message. When you're presenting data, you have to remember that even though there are scientific ways of presenting data that your peers understand and that are the "correct" ways academically, the people you are trying to convince may not understand this type of presentation.

Here's an example of two ways of presenting a map. The first one (Figure 1) is very detailed. It was used in presentations to local government. The project was the daylighting of a stream, and it was important to show the exact blocks that would be affected, because the city was going to have to pass ordinances, approve construction, and so on. The other map (Figure 2) shows the same area and the same project, but it was presented to the public to get them excited.

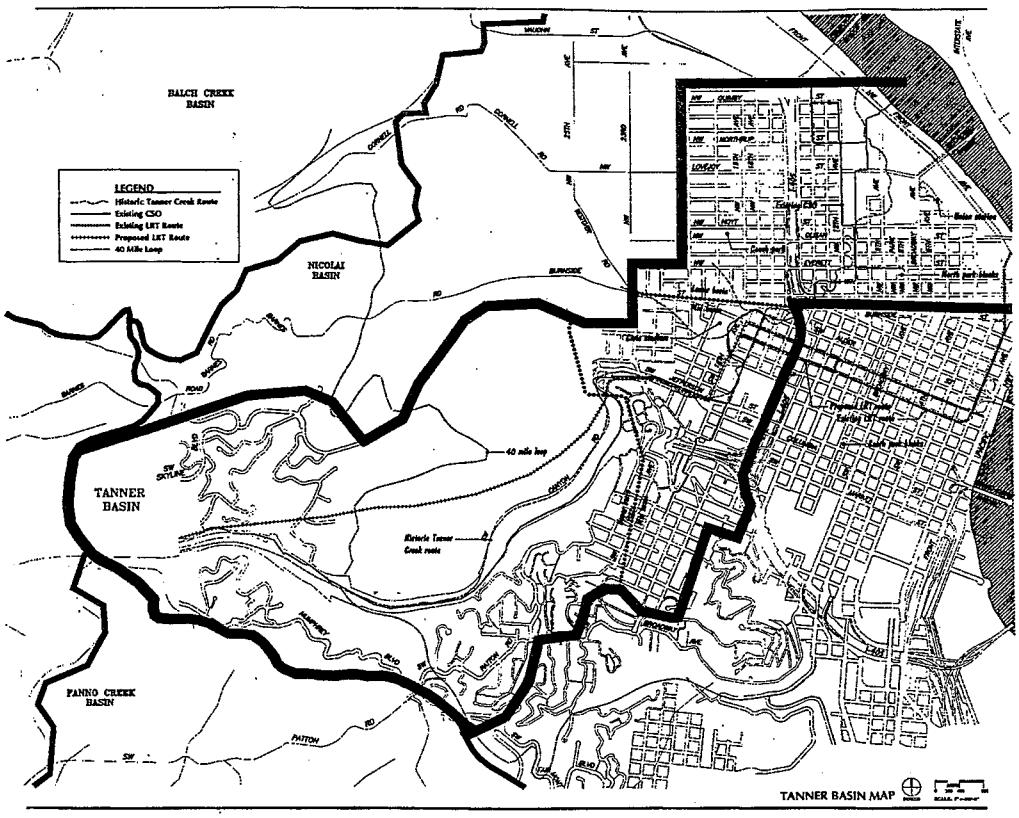

Figure 1. This map of the project area was presented to local government agencies.

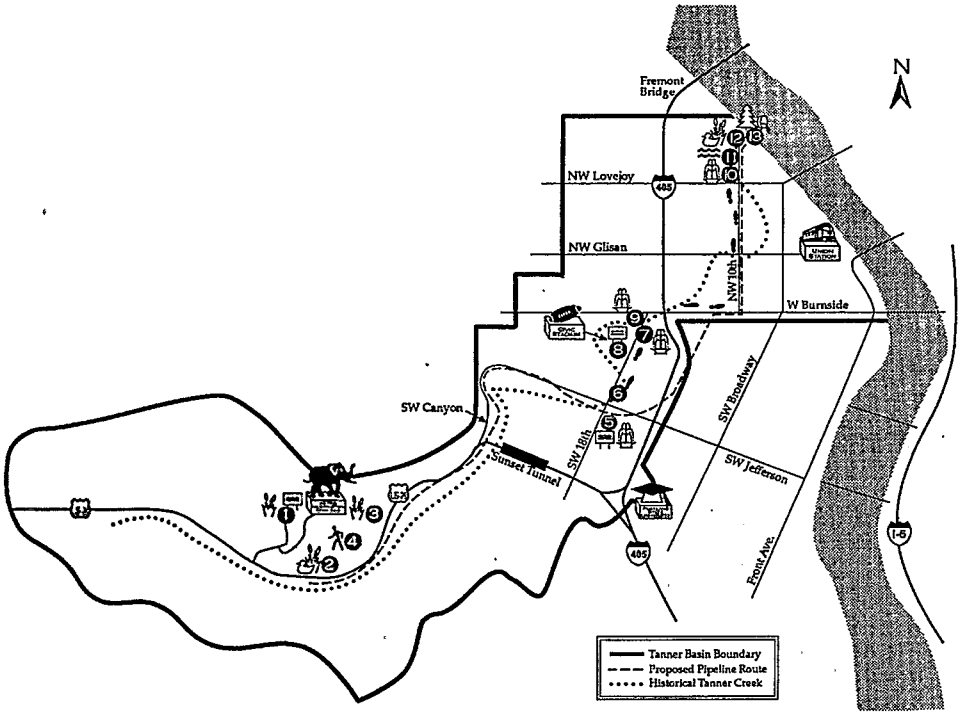

Figure 2. This map of the project area was part of a brochure written to increase public awareness.

Getting attention

After you've determined who your audience is, you have to get their attention. That might be the harder part. A lot of you don't have a big budget for graphics and color, so the first thing you need to think about are the words you will use.

Consider two possible headlines for the same brochure: "Monitoring Balch Creek, Winter 1994" or "Watch Out for Balch Creek!" If I was flipping through my mail, the second one would be more likely to get my attention.

So here is your reader—she's at home, she's listening to her answering machine, her kids are talking to her, her bills are on the table, but she's kind of interested in this "Watch Out for Balch Creek!" So she opens the brochure, even though she still hasn't figured out what she's going to cook for dinner. You need to make sure that she can get your basic story just from the subheads, because they may be all she has time to read. If she's interested in one topic, she can read more in that section. Give readers options for ways of getting your message—they shouldn't have to read your 12-page report.

Type faces are also important, although I think that a good headline will take you a lot further than type will. Type communicates to us in ways that we aren't even consciously aware of.

Jana Suchy
Tetra Tech, Inc.

Packaging Your Message Effectively

Let me start right off with the three main points I'd like you to walk away with.

1. **Your message is only as good as its packaging.** Packaging and distribution are the weak links to a strong message.
2. **These are the 90s. Things got sleek.** Look around you: The 50s were cool, the 60s were far out, the 70s were hip, the 80s were slick, and the 90s are sleek.We must effectively compete with the MTVs out there. I do not at all advocate forsaking substance for splash: you have to have a strong, worthwhile, valuable message—but you've got to dress it up.
3. **Make your message nuggets worth their weight in gold.** If all of your information spans a mile, your best-case scenario is that you will effectively convey an inch of that mile.

Here is an example of a "fact sheet." A fact sheet is black type on white paper, and it's the most boring, low-technology thing in the world. Now here's what you can do to dress up the message. First is a short slide program with loon calls on the sound track. Another is an original song composed by a blues band on the theme of "Got the blues 'cause your lake is green?"

You can get more bang for your buck by using more than one medium: a fact sheet and a radio spot and a poster. Here's a poster we designed—on the back of the poster is all the information that was on the fact sheet.

You can do an effective and beautiful title slide by using interesting colors. Everyone uses black, white, blue, and gold. There are more colors than those. Or you can use two colors at once. If you are going to use just words, fill the screen. And use magenta!

Lynn Kramer
Herring Run Watershed Association

Presenting Your Vision

My role on this panel is to focus on oral presentations and the importance of presenting your information with clear messages, with specific requests and opportunities for action, and, most importantly, with a vision of what you see is possible if those actions are taken.

Enrollment

Presenting information with clear messages and vision and then presenting opportunities for action are all part of the process of enrollment. Much of our life is spent either enrolling people or being enrolled. It can be as simple as enrolling a friend into going to the movies with you, or it can be something complex like enrolling the City Council into taking action to stop an incinerator from being built. It's all enrollment, and I don't think facts and figures alone are what enroll people.

The experience I am drawing from is the experience I've gained over the last two years enrolling people—first, into working with me on planning and conducting a stream survey of the Herring Run, and subsequently, into taking action on the data that were collected in that survey. In both instances I had information to present to people. In both cases, I wanted people to take certain actions after hearing the information I had presented.

[Editor's note: For a detailed description of the Herring Run Stream Survey, please see Lynn Kramer's presentation in Session 2, "From Data to Action, Part One."]

When I began the process of enrolling people into the idea of planning and conducting the stream survey, the information I had to present was minimal: What and where the Herring Run is, and what a stream survey is. Now, do you think presenting those facts alone would enroll people into helping me plan the project?

A vision of possibility

I don't think so. I say what enrolled them into planning and conducting the stream survey was the vision and the possibility of the project that I presented to them. When I chose this project, I was in a Landmark Education Corporation program called the Curriculum for Living. In the program, you develop a "Statement of Possibility"—a statement about what you say is possible for the future that really lights you up and that will determine your actions in the present. So the possible future I have created for myself and am living into is the possibility of community and relatedness—people living in harmony with each other and the earth around them. It's the possibility of this future that got me beyond my discomfort and up in front of community associations asking them to take action.

People connecting

To me, the stream survey naturally fit with this possibility of community and relatedness because it was about people reaching out beyond neighborhood boundaries, working together with other neighborhoods as part of a larger, nature-based community with a healthy waterway as its primary focus. For me, that's what it's really all about: People connecting who might not normally connect. Folks from one neighborhood helping to plant trees in another neighborhood. Black kids and white kids, 6-year-olds and retired people building bird houses together. That's what the possibility of the stream survey was, that's what enrolled people, and that's exactly what is happening now as a result.

At any rate, the first community association I spoke to about these possibilities gave me their official support and three people volunteered that night to help me plan the project. One of them is now the Vice President of the Association and the other does pro bono art work for us. Seven weeks later, 18 of us held our first planning meeting. Seven weeks after that, with the help of Maryland Save Our Streams, we held the stream survey and 100 volunteers showed up.

The distinctions I learned in the Curriculum for Living—speaking the possibility of your project and giving others an opportunity to explore what it would mean for them; acknowledging them for their concern (even if it's only for showing up to hear what you have to say); and then offering them opportunities for action—are some of the most valuable distinctions I've learned in life.

It was these distinctions that were applied to the presentations of the stream survey results that were made to the public and to the City Council.

At the community presentation, we again spoke about the possibility of the Stream Survey and we applauded how many communities had worked together to make it a reality. Stream survey participants were acknowledged for their efforts, and those who were present were acknowledged for the concern they were showing by attending the meeting. We made sure people understood what an accomplishment the stream survey was (DPW was already addressing problems, a City Council hearing was set). And we presented specific opportunities for action right then and there. Before leaving, people divided into planning groups (tree planting, storm drain painting, cleanup, or watershed association), discussed their projects briefly and set a date to meet again.

At the City Council meeting, we talked about that same possibility (which by now had become a reality) of community—diverse neighborhoods joining together into a larger watershed community to take action on something they really care about. We emphasized that our newly formed association was going to keep that watershed community alive. We showed our strength and commitment by the large number of people in attendance. We acknowledged past efforts and accomplishments by the City in the Herring Run Stream Valley and made special reference to the concern that had been shown by the City Councilman who had not only participated in the survey but had also set up the televised hearing for us. And finally, we made some specific requests, one of which was to be assigned a City Councilman on the Health and Environment Committee who would act as our liaison to the City Council.

It was the combination of all these components, as well as the actual data we presented, that served to make the stream survey such a success.

So collect your data. Develop the most visually effective report possible. But don't forget why you're doing it. Why do you want people to take action? What is your vision of the world when all the problems you are uncovering are handled?

Picture what's possible . . . and speak about it to anyone who will listen!!

Monitoring Restoration and Pollution Prevention Activities

Moderator: **Jonathan Pearson,** Maryland Save Our Streams
Presenters: **Jonathan Pearson; Gayla Campbell,** Texas Natural Resource Conservation Commission; **Susan Barthel,** Portland Bureau of Environmental Services; **Mike Rigney,** Coyote Creek Riparian Station

Jonathan Pearson
Maryland Save Our Streams

Monitoring Construction Sites

Maryland Save Our Streams is a 24-year-old nonprofit group that works to organize volunteers across the state and involve them in activities aimed at river and stream restoration and stewardship. Through our Adopt-A-Stream program, we have several activities aimed at addressing the problems related to nonpoint source pollution.

The activity I've been asked to touch on today is our use of volunteers to monitor construction sites for sediment pollution. Sediment, or mud pollution from construction sites, is one of the largest single problems affecting the health of Maryland streams and the Chesapeake Bay.

My personal observations are that (a) the state of Maryland has relatively strong sediment control laws, (b) most contractors make a good to excellent effort to adhere to those regulations as a project gets underway, and (c) the biggest problem comes in the long-term maintenance and adherence to those regulations.

Thus, the need for vigilant volunteers to watch over construction sites is very, very important.

Training

SOS trains citizen volunteers on how to be effective monitors. We do this in two basic ways:

1. One way is through our Adopt-A-Stream program. At a volunteer's request, we will send a packet that highlights information the volunteer needs to know about how to monitor a construction site. The packet includes literature that outlines what to look for, how to tell if a site is in violation, and how to go about correcting the problem. The packet also includes basic data sheets which the volunteer can use to record his or her findings. In addition, we can make available a slide show that discusses why sediment pollution is such a large problem, and provides the volunteer with pictures of the kinds of problems he or she is being asked to look for.

2. The second, and preferred, way to train volunteers is through a workshop. The basic components of our construction site workshop are as follows:

- Provide each volunteer with a packet of information, containing much of the same information included in our Adopt-A-Stream packet.
- Invite the participation of state inspectors, local inspectors, and contractors.
- Conduct an indoor training session that goes through the basics of construction site monitoring.
- Give volunteers the information they need regarding procedures to follow when reporting a violation. Include the names, addresses, and phone numbers of appropriate contact people.
- Go on a tour of active construction sites to observe firsthand the information provided during the training.
- (Perhaps most important) For the targeted region, identify and list active construction sites and encourage the volunteers who attend to "adopt" one of these sites and monitor it on a regular basis.

Successes

Our successes include the following:

- **Correcting violations.** We have had dozens upon dozens of instances where volunteers have successfully reported violations and had problems corrected.
- **Changes in policy.** Building a base of active volunteer monitors can lead to stronger sediment regulations. For example, in 1984 an SOS campaign in which volunteers conducted a large-scale review of sediment controls in Anne Arundel County, Maryland, resulted in the doubling of County inspectors. In another example, legitimate concerns raised by volunteers helped bring about policy changes within the Maryland State Highway Administration. The SHA now rates contractors on sediment control measures; poor ratings can result in contractors not being given future projects. Another major change in policy is that at every point where a state road project crosses a stream, monitoring is now conducted before, during, and after the project to determine the extent of stream degradation, and whether mitigation is required at the site. SOS volunteers are beginning to play a role in this monitoring effort.
- **Building bridges of cooperation.** Seeking the involvement of contractors in workshops and site visits, and writing letters of praise when good sediment controls are in place (as opposed to simply writing letters when sites are in violation), can establish an atmosphere through which positive improvements can be made.

Failures

Our one big failure has been our inability to recruit adequate numbers of volunteers for construction site monitoring.

Ideally, we could use volunteer monitors for every construction project. However, it is more difficult to recruit volunteers as construction site monitors than it is to, say, conduct a stream cleanup. I would cite several reasons for this:

1. More than any of our other projects, construction site monitoring is directly confrontational. No matter how cooperative you try to be, the bottom line of the activity is seeing that laws are enforced, both by contractors and the enforcement agency. If the laws are not being enforced, it becomes the job of the volunteer to report violations and violators. For some volunteers, this can be uncomfortable.

2. There is a significant time commitment. This pertains not only to the initial training time, but also to the time needed to monitor an adopted site, sometimes on a regular basis. To truly monitor a construction site to see if a contractor is violating laws regarding temporary stabilization of bare soil, a volunteer needs to visit the site on a daily basis. Volunteers also must take the time to contact, speak to, and follow up with inspectors; to write letters to contractors and government officials; and, hopefully, to send their findings back to our office.

3. There is also a financial commitment. Basic costs consist of gas, stationery, and stamps. Moreover, the most effective monitors are those who document their findings through photographing or videotaping. Such documentation can strengthen a volunteer's ability to get a response; however, it costs money.

I want to stress that volunteer monitors can be useful, and quite successful, if they simply take on the task of observing and reporting when fences designed to catch sediment have fallen down, or are not in place.

Recommendations

Let me close by leaving you with two recommendations on how groups can try to make their construction site monitoring program as successful as possible:

1. Arrange weekly site visits with state and/or local inspectors. Make arrangements to walk a construction site with the inspectors. This can help to educate volunteers further, as well as build stronger levels of cooperation and understanding.

2. Organize an annual large-scale event. For example, each year, conduct a "State of the Sediment Fences" survey. Set a goal to have your volunteers investigate 100 construction sites in a region, to determine what percentage of those sites have sediment fences that are properly maintained. Schedule the activity for a traditionally rainy month, when well-maintained fences are most critical. Give the volunteers a 30-day period in which to survey their sites. Alert the regulatory agencies and the associations representing contractors that this activity will be taking place. After the information is in, release the findings to the agencies, the associations, and then to the news media. Hold a press conference to announce your findings.

Gayla Campbell

Texas Natural Resource Conservation Commission

Texas Watch Nonpoint Source Program

Texas Watch is the statewide volunteer environmental monitoring program of the Texas Natural Resource Conservation Commission. The goals are:

To produce environmental information that agencies, waste generators, and the public need to make environmentally sound decisions;

To resolve conflicts over environmental impacts through positive cooperation, and

To improve communication about the environment and environmental issues.

The program unofficially started in 1987 through citizens' concerns about fish kills on a river in western Texas. Through their efforts, the amount of environmental information about the river increased and communication with the agency improved. In 1991, Texas Watch became an official program. Presently, the program has over 4,000 volunteers, with teachers and students making up approximately 40 percent.

Texas Watch offers several levels of training, ranging from educational programs to the certified monitor, trainer, and quality assurance officer level. These levels provide the framework for volunteers to collect quality-assured data that augments professional data-gathering efforts. Together, volunteer and professional data provide a more complete picture of water quality in Texas which can then help focus efforts to address present and future environmental issues.

Although Texas Watch presently focuses on water-oriented volunteer activities, the program will be expanding in the next several years to include biomonitoring, air monitoring, and observational monitoring, such as watershed walk components.

The Texas Watch nonpoint source program has several distinct project areas. Presently, the program has two 319 grant projects with a third one to commence in September. Texas Watch activities will be included in the new statewide nonpoint source management plan, which must be approved by EPA Region 6 to apply for federal 319 grant funds.

The overall purpose of these projects is to educate communities about actions that contribute to nonpoint source pollution and involve citizens in the prevention and control of it by training them to collect and test waterways in their communities. The goal is to increase awareness and encourage changes in individual behavior to reduce water pollution. The effectiveness is measured by the changes in water quality through the data collected by trained volunteers.

One project focuses in four urban areas and the other in two agricultural areas. Both projects are individually designed to incorporate the needs of each city and community in identifying nonpoint source pollution problems, control-

ling them through various best management practices (BMPs), and preventing further pollution by educational outreach activities.

Three of the four cities will have volunteers trained to collect the five basic variables: pH, conductivity, dissolved oxygen, temperature, and transparency. They will also note weather and visual characteristics of their sites. In addition, volunteers will collect water samples for laboratory analyses for fecal coliform, orthophosphates, and nitrate-nitrogen. The fourth city will train volunteers to use a storm drain monitoring kit for testing pH, temperature, detergents, copper, chlorine, and phenols. Volunteers will also test for ammonia. Dry-weather sampling of storm-drain outfalls will augment the sampling done by the city. The data collected in these areas will augment professional data-gathering efforts, and help identify problems and evaluate the effectiveness of non-structural BMP implementation such as storm-drain stenciling projects.

The project focusing in two agricultural areas will encourage the involvement of the agricultural community and will have volunteers collect the same five basic variables as well as fecal coliform, orthophosphates, and nitrate-nitrogen. The data will help evaluate the effectiveness of structural BMP implementation carried out through technical assistance programs.

Presently, amendments to the Texas Watch Quality Assurance Project Plan (QAPP) are in the EPA approval stages for the fecal coliform and nutrient sampling components. An important part of the success of these outreach projects are partnerships with the cities, communities, river authorities, councils of governments, and laboratories who assist Texas Watch by providing various types of in-kind services.

The third project, commencing in September, will focus on adjacent urban watersheds. The goals will be to decrease the load of toxics and other urban nonpoint source pollutants entering the creeks by implementing effective non-structural BMPs and encouraging the implementation of structural BMPs, and to evaluate the effectiveness of those BMPs using trained volunteers and a paired watershed design. The project will use a holistic approach involving concerned citizens, students, teachers, and businesses.

The monitoring design will allow quantification of the effects of a series of BMPs on water quality, adding to the body of knowledge on BMP effectiveness. A paired watershed monitoring design is the best method for determining effectiveness in a short period of time.

In addition to the five basic variables sampled weekly, volunteer monitors will be trained to sample for benthic macroinvertebrates on a quarterly basis. A QAPP for this biomonitoring component will be written, and approved by EPA, before monitoring commences.

This paired watershed design project using volunteers is on the "cutting edge" and it is hoped the success of this project can assist other volunteer groups in implementing successful water quality studies in cooperation with their local and state governmental agencies.

For more information concerning the Texas Watch nonpoint source program, please contact Joan Drinkwin, Nonpoint Source Project Coordinator, at 512-463-8540.

Susan Barthel

City of Portland Bureau of Environmental Services

Monitoring Improvement Efforts in the Columbia Slough

My responsibilities right now are with programs that are going to affect the water quality and multiple objective uses of the Columbia Slough. Some of you already know the Slough as an 18-mile body of water just south of the Columbia River.

The Slough is quite a complex area. This 18-mile-long reach crosses three jurisdictions. There are three cities involved. The Slough begins at Fairview Lake, with a stream that drains a lot of the eastern part of the city of Gresham. The top eleven miles are all diked and leveed and controlled for flood protection and irrigation purposes.

There are drainage canals throughout this area. The Slough crosses under the Interstate Bridge. This area is targeted for heavy industrial development. The slough also goes through a large area that hasn't been sewered. There are about 52,000 households that have been on septic systems that are contributing a lot of bacteria to the Slough.

Last fall, Ralph Rogers, the Watershed Manager, the Outreach Educator Ivy Frances, and Diana Hinton (who at the time was doing work that I'm now doing) organized the first volunteer monitoring effort on the Slough. It was specific to a particular effort that is part of the city's plan to improve basic water quality in the Slough—a pilot test to lower the level of water in the upper part of the Slough by about 8 inches to see whether the increased flow would reduce the amount of bacteria, and what kind of effect would be noticed on wildlife and other habitat. Also, there's not a real good baseline, and so we're establishing the first-ever baseline during an atypical period of time on the Slough.

Although we had a only short time to organize it, recruitment was fairly broad. We included ads in *The Oregonian* and *The Asian Reporter,* and articles in *The Audubon.* We're forming a watershed stakeholders committee, so there were presentations there, and we got some volunteers from that. A number of local teachers were involved. We had doorhangers that the Bureau's Youth Team distributed, and we had booths at some ecology events.

The volunteers recorded vegetation growth, illegal dumpsites in the stream and on the side of the stream, wildlife, and birds. The frequency varied. Some people did almost daily observations, though we asked for somewhat less than that.

A couple of things we learned: (1) Summer vacations interfere with recruitment efforts—at least here in the Northwest. I think August is a lost month. (2) We had a problem getting information back from some volunteers. And, we also had a problem giving information back to them, frankly.

We're now gearing up for the second round of monitoring. It was lots of fun, and we did receive some really valuable information about the effects of lowering the level of the water. In some places, there were culverts that were clogged. That was obvious rather rapidly. And in some places we didn't get a drop in water level. So that was interesting, and it provokes the idea that we need some further study.

Mike Rigney

Coyote Creek Riparian Station

Inventorying Riparian Resources in California

It is always a shock to people involved in volunteer monitoring programs when I mention that the Coyote Creek Riparian Station, established just last year, is one of the first volunteer stream monitoring and riparian habitat inventory projects in the state of California. How can this be, people often respond, when California is considered by most to be a leader in environmental issues? The reasons are many, including rapid expansion, manifest destiny, the legacy of John Wesley Powell, an abundance of concrete, and Ronald Reagan. The bottom line, however, is that little attention has been paid in California (and for that matter most of the arid West) to the preservation of natural waterways, while a great deal of attention and financial resources have been spent on methods of capture and transport of water through dams, canals, culverts, and pipes.

It is estimated that 90 – 95 percent of all riparian habitat in California has been eliminated or substantially altered. With such a small fraction of this valuable habitat left, it seemed important to a number of us involved in riparian resource issues to know where the remaining areas of suitable habitat were and began a process which would ultimately lead to protection and restoration. In 1992, our organization, the Coyote Creek Riparian Station, a nonprofit research organization based in the southern San Francisco Bay region, applied to Region 9 of the U. S. Environmental Protection Agency for funds to implement a watershed demonstration project. This demonstration project would develop methods to inventory riparian resources in Santa Clara County (home of Silicon Valley) and begin a baseline water quality monitoring program on several of the major streams in the county. And we wanted to accomplish this task by using trained volunteers to collect the field data. Not a novel concept in the East and Pacific Northwest, but this was—and, as far as I know, remains—the only program of its kind in California.

Being the first to develop such a project in the state, we struggled through many of the processes that older, more established programs dealt with probably 20-odd years ago. However, being the new kid on the block gave us the advantage of building upon what these groups had discovered through experience. What we learned quickly, though, was that you could not necessarily transfer programs and protocols which work in the East to the arid climates of the West where many streams flow only sporadically. Intermittent streams pose special problems for those of us who wish to categorize and characterize. We found it difficult, for instance, to use stream invertebrate classification systems such as those developed by the Izaak Walton League in streams which were dry during most of the summer. Yet, as a wildlife biologist, I knew that these streams provided critical habitat for birds, mammals, reptiles, and amphibians, despite the fact that they ran dry. We therefore chose a combination of biological factors (including basic water quality parameters and invertebrate sampling) which we felt represented a broad picture of the whole ecosystem as the foundation for our stream inventory process.

In order to tie the inventory into urban runoff and pollution prevention programs, we created a more encompassing program that we called Community Creek Watch. After training creekside residents on inventory procedures, we began a program of regular surveys for nonpoint sources of pollution and illegal dumping. These surveys fed into newly established stormwater pollution monitoring programs being established by each of the counties within the greater San Francisco Bay area.

We now have well over 100 trained and active volunteers assessing and inventorying riparian habitat in Santa Clara County with information related to pollution, illegal dumping, and best management practices funneling to the appropriate local and state agencies. And the process is spreading to other Bay Area counties. There are plans being formulated currently to create similar "riparian stations" in all of the major watersheds of San Francisco Bay. We may be late bloomers, but the concept of volunteer monitoring is now flowering in some portions of dry California.

Discussion Session

After the presentations, participants in the workshop broke up into small groups. Each group discussed a problem question and reported back to the full group. The following is a summary of those discussion groups.

Scenario #1

A volunteer group, working in cooperation with a local water district, does a habitat inventory of a particular watershed, in which some of the land is privately owned. The inventory is done with permission of the landowner. However, results of the inventory show a habitat area partly on private land, partly on public land, which is home to an endangered species of plant. The landowner now denies giving permission for the

inventory and does not want the endangered species habitat information to be used.

Challenge: Develop a strategy for addressing this problem and reaching an agreeable resolution of the problem.

Discussion: The discussion group identified several questions they would want to investigate prior to developing a strategy. These included: (1) Will publishing the data hurt the reputation of the volunteer monitor? (2) Why not just use the information from the public portion of the land? (3) How can someone *prevent* the use of data? (4) Why was there no written record of the landowner's original permission?

Strategies that incorporated a "best-case" scenario included:

(1) Approaching the landowner in a non-threatening manner; (2) Explaining what the Endangered Species Act means; what are the implications; (3) Proposing a land exchange; (4) Proposing a donation, easement, or tax break; (5) Involving the landowner's peers.

Possible outcomes listed under the "worst-case" scenario included: (1) The volunteer group provides information to the government agency with jurisdiction (a "last-case" scenario?); (2) The landowner doesn't want the area seen as unique and special; (3) The neighbors join forces against the "Granola Heads"; (4) The landowner destroys the plant to end the issue.

A further suggestion was the possible relocation of the plant, if it is on a small enough tract of land and if it transplants well. It was also noted that the volunteers have to deal with the emotional content of the landowner's argument in addition to the rational.

The group concluded by noting that if they were dealing with a dishonorable individual or company, they may have to go the legal route.

Scenario #2

You head a volunteer group in a small, urbanized watershed. The stream is channelized and has unstable streambanks, low habitat diversity, stormwater discharge, and high toxic loading into receiving waters. It is in a low socioeconomic residential community with very mixed land use. There are restaurants, gas stations, small strip business areas, and, of course, large areas of impervious surface. There is limited public access to the creek, and the community is an untapped resource. The city and state are both involved via state and federal grant money.

Challenge: Assess and evaluate the monitoring needs within this watershed, and develop a strategy for involving volunteers in such a program.

Discussion: The first recommendation involved getting baseline information. Gather information on toxics and on habitat degradation. Identify problems related to health, garbage, and aesthetics. Outreach into the community was also recommended.

These strategies were further outlined as follows:

1. Identify needs and a "vision" by conducting a survey, holding public meetings, and engaging in one-to-one conversations.
2. Set goals by consensus. Possible goals include increased access and better aesthetic quality.
3. Design a monitoring program.
4. Educate through surveys, meetings, etc. Raise awareness through activities such as a cleanup or a "stream day."
5. Publicize the results.
6. Secure funding to hire a local coordinator.

Scenario #3

Your volunteer group has been active in a watershed with mixed urban and rural land uses. In many areas the stream is natural with good habitat quality, while in other areas it is highly impacted by a variety of urban activities. You have been successful in lobbying local jurisdictions to implement protection and restoration processes. These agencies are now looking for input from your organization on how and where to focus their efforts.

Challenges:

1. Discuss ways of prioritizing and implementing these efforts, ensuring your organization's continued participation in the process. Be sure to discuss the issue of prioritizing between the protection of "good" areas in order to halt degrading factors (including urban runoff) versus focusing your efforts on restoration.

2. Discuss within your group the following: (a) Particular areas of monitoring of nonpoint source pollution and/or best management practices where you believe volunteers are currently being underutilized; (b) Reasons why volunteers are being underutilized in those particular areas; (c) Recommendations on how to reverse this underutilization.

Discussion: The group had the following recommendations in response to question 1:

- Take a watershed approach instead of isolated problems/solutions.
- Have a demonstration restoration program.
- Have a common vision of the watershed.
- Have a balanced approach between protection and restoration.
- Try to determine what is best for the river.

The group listed the following in response to question 2:

1. Area where volunteer monitors are underutilized = **Construction site monitoring.** Reasons for underutilization of volunteers = Political (concerns on the part of agencies); staffing needs. Possible solutions = Organize site walks to build cooperation/understanding; hold an annual large-scale event.

2. Area where volunteer monitors are underutilized =

Direct measurements of structural BMP's. Reasons for underutilization = Training, access, liability. Possible solutions = Start with entry-level observational monitoring.

3. Area where volunteer monitors are underutilized = **Monitoring nutrients, particularly septic.** Reasons for underutilization = Ammonia not held to solid standards; tests are difficult; it takes a lot of training. Possible solutions = Just do it. While there may be problems, the best way to start addressing those problems is by getting a program under way.

4. Area where volunteer monitors are underutilized = **Stream temperature.** Reasons for underutilization = Cost of equipment. Possible solutions = Coordinate with groups that own equipment and want to share it.

Also mentioned as areas of underutilization of volunteers: wetlands, particularly measuring the success of restoration or mitigation projects; monitoring within the business community, both outside looking in and inside looking out; and using more volunteers in education efforts.

Involving Volunteers Effectively, Part Two: Developing Leadership

Moderator: **Abby Markowitz,** Maryland Save Our Streams
Presenters: **Abby Markowitz; Wes Halverson,** LBJ Science Academy of Austin; **Pat Reese,** Friends of the Fox River

Abby Markowitz
Maryland Save Our Streams

Developing Leadership Among Volunteers

The purpose of this workshop is to explore issues around developing leadership among volunteers. Wes Halverson's presentation deals with leadership among students and teachers. Pat Reese focuses on organizational leadership in the boardroom. I'd like to discuss why we should develop leadership; what makes a leader; and how we develop leadership among the adult volunteer monitors in our programs.

Why should we develop leadership?

Perhaps the simplest, and most often overlooked, reason is that volunteers in leadership positions make the notions of "volunteer monitoring" and "citizen involvement" more than just slogans. Volunteers can play an integral and critical role beyond the actual collection of data. Other significant reasons why leadership development is a vital component of Maryland Save Our Streams (SOS) programs are that it:

• **Builds a stewardship ethic.** One thing that virtually all volunteer monitoring programs have in common is the desire to develop an environmental stewardship ethic among the populations of people we work with. We want to increase the public's awareness of water and resource issues and to build a sense of responsibility for all our actions that influence water and watersheds. Leadership among the volunteers in our programs is a critical ingredient to building environmental stewardship. In fact, I think our long-term success—in collecting data and using it effectively to promote positive change—is tied to our ability to create and nurture volunteer stewardship over the monitoring programs themselves.

• **Shares the workload.** I have yet to see the monitoring program that could not benefit from a larger pool of people participating in coordination. Most volunteer monitoring program managers I know often bemoan the incredible work load and attention to detail that is critical to sustaining—much less expanding—the program.

A strong core of volunteer leadership can help strategize, develop, and implement one, a few, or many of the tasks relating to program coordination, such as:

- recruitment and retention of volunteer monitors
- publicity and media relations
- interacting with partners and data users
- interacting with other monitors in the program
- developing data forms, manuals, and training procedures—especially, serving as a "reality check" to ensure that written materials contain volunteer-friendly language and explanations
- data presentation
- actual training of volunteers
- data management
- fundraising and other resource development

Increases credibility and outreach: Volunteer monitoring programs need to be credible to data users, data collectors, and the larger watershed population (businesses, media, foundations, communities). My experience has been that a program visibly represented by a strong core of volunteer leadership is taken more seriously than one in which staff are the only visible spokespeople.

One clear example is in media relations. Reporters sometimes are skeptical of what I say; they assume that my agenda, as a staff member, is simply to publicize and promote SOS. However, in instances where volunteers have followed up with reporters by phone—and in person—we have gotten more in-depth press coverage. Local television and newspapers love to interview and film committed and articulate volunteers who do this work not because they are paid but because it is important to them.

Also, we have found that monitor recruitment, retention, and attention to QA/QC are increased when members of our volunteer Steering Committee interact with other monitors. Volunteers respond to their peers. Three years ago, a member of the Steering Committee was lost on her way to a monitoring session. She stopped to ask directions and got to talking with someone about the program and her involvement in it. That someone was intrigued by her enthusiasm as a volunteer and decided to tag along for the session. He is now the outgoing Chair of the Steering Committee.

Also, relationships with government agencies and elected officials are strengthened through volunteer investment. In our Baltimore County program, many decisions are made in partnership among the volunteer Steering Committee, the County government, and SOS.

What makes a leader?

Although some may disagree, I don't believe that every volunteer is a leader. This does not in any way diminish the role that every volunteer plays. It does mean that there are some distinctive skills, qualities, and characteristics associated with leadership. A leader is someone:

• who is invested and has ownership over a program or project

- who motivates others to become involved
- who takes on increasing responsibility, and follows through on tasks
- whose opinions are respected and who can build consensus
- who can effectively delegate responsibility
- who builds a constituency and fosters leadership skills in others

How do we develop leadership?

As is true of most areas involving human behavior, leadership development is far from an "exact science." People are individuals with different motivations, interests, goals, etc.

Leadership development demands a **strong commitment on the part of organizations and agencies to the process.** The willingness to develop leaders requires an understanding that power over the program will be shared. Handing some control or decision making over to others is sometimes a frightening proposition to program managers. However, if you are not willing to do this, you will have "mascots," or tokens—not leaders. And, most likely, you will not have them for very long. Volunteer "leaders" should not be people who are paraded out for show when the occasion strikes.

Back in 1989, when we were developing "Project Heartbeat" (our volunteer bioassessment program in Baltimore County), we began by forming a Steering Committee of volunteers who had been active in other local SOS projects. But simply having a "Steering Committee" didn't mean we had a ready-made group of leaders. Leadership development is a long process, and the formation of that group was the beginning—not the end—of that process for Heartbeat. Very few leaders that I have known have sprung up overnight. This work needs to be a stated, primary goal of the program. It must be just as important as education and data collection.

As I said before, not every volunteer is a leader. Learn to **identify volunteers with leadership potential and foster that potential.** One skill I have tried to learn is to treat every new volunteer as a potential leader. Look for people who ask a lot of questions. If your program asks for volunteer evaluations, look for people who take this seriously and who give in-depth and thoughtful answers to evaluation questions.

Part of learning to identify leadership potential is learning to look between the lines and really hear what people are saying—**don't just listen to their words.** The first time I met Olga, she was complaining to me—rather vigorously—about some logistical problem during a monitoring session. I remember thinking, "I'll never see her again." During that session, we made a plea for new committee members. Much to my complete surprise, Olga showed up at the next Steering Committee meeting and has stayed ever since. What I mistook for simple "griping" was really someone who saw that things weren't perfect and felt that she could contribute to improving them. I learned that when people bring up a problem, I should not assume they wouldn't be willing to work to correct it. I also learned that listening and hearing are not always synonymous. I had listened politely to Olga, but I had not really heard her. I wonder, now, how many people I've "lost" because I didn't really listen to what they were saying or because I didn't come right out and ask if they would be willing to help figure out a solution. So, don't be afraid to ask volunteers directly if they are interested in becoming more involved. Get to know the volunteers involved in your program as people. What are their interests; what do they do for a living; what brought them to this program? Develop trusting relationships with them.

Provide opportunities for volunteers to grow by developing new skills and experiencing increasing levels of responsibility. Look at your program and determine what opportunities exist for leadership. The Steering Committee was our first opportunity for leadership. Of the original 25 people who came to the first meeting, about five are still on the committee. Over the years, others have joined, some have left, and we currently have about 15 members, four of whom are new since 1994. The "SC," as it is known, is currently working on developing our Heartbeat Volunteer Handbook, planning a fall 1994 conference, improving monitor recruitment and retention strategies, and identifying new members for the committee. Each of these projects provides an opportunity for members to learn new skills, gain confidence in their abilities, and take on new levels of responsibility.

In addition, several members of the SC have forged relationships with our primary data user, Baltimore County. The SC plays an active role in all decisions regarding the program, including site selection and evaluation. In this way, these volunteers have a hands-on responsibility in making sure the program achieves its goal of providing critical data needed to implement watershed protection and management policies.

Allow people to develop and implement their own ideas, even if you don't always agree. Over the last several months, as we have worked to develop our Volunteer Handbook, the SC has engaged in "heated" discussions around content, style, and level of sophistication. Sometimes it felt as if we were going around in circles and not being as productive as I would have liked. But in reality, these arguments were an extremely valuable part of the leadership development process. These folks were taking ownership of this project in a very real way and we were all learning to act as a group and to build consensus. When we finally agreed on the outline of the Handbook, writing assignments were delegated to various members. As I read the drafts submitted for various sections, I was tempted to do rewriting—not because there was anything wrong, but because it was not how I would have written it. For me, one of the most difficult lessons to learn—and to adhere to—was that my way isn't always the right way. Leaving the pieces intact meant that the Handbook really was a *volunteer handbook,* not a document written by staff for volunteers.

Sometimes I think of leadership development as if I were organizing the seating arrangements for a dinner party—

putting people together who share a common interest, who can learn from each other, and who will help make the party (or monitoring project) a success.

It is important to provide an atmosphere that encourages existing leaders to develop a relationship with and serve as a mentor for a new volunteer. For example, when Mike, a high school biology teacher, went out in the field with Heartbeat for the first time, I deliberately teamed him with Carl, one of the SC members and a university biology professor, because I had identified Mike as a potential leader. Mike later told me that Carl was probably the best first partner he could have had because they shared many interests and because through Carl, Mike realized there was a place for him in this program. In the ensuing two years, Mike has trained many new monitors, has donated the time of his classes to repair kick-seines, has been an enormous help as a supervisor in the taxonomy lab, and has recently joined the Steering Committee.

We recently had a party for the SC Chair, who is moving West to attend graduate school. As we were all hanging out, eating a cake with a big stonefly made out of chocolate frosting, I looked around and was amazed at this group of people. Through this monitoring project we had become important to one another. The process of leadership development was really the process of building a community, fostering a sense of belonging, creating connections, and making friends who touch your life and are sorely missed when they go away. In the end, there isn't any better reason to do anything—including developing leaders.

Wes Halverson, Ph.D.

Colorado River Watch Foundation, Inc.

Techniques That Build Leadership Among Teachers and Students

When high school students Inga Adams and Chani Gilfeather spoke to this conference two years ago, they electrified the audience with their speaking style, charm, and in-depth knowledge of the Colorado River of Texas. The reaction they got was fabulous, but not unexpected. We had watched these two young people come up through our organization and grow into articulate, forceful, and powerful leaders. Jack Goodman, CRWN Coordinator, chose these two students to represent the Colorado River Watch Network for all the right reasons: They could represent the future generation; they had highly developed speaking skills from first-hand experience in front of the Austin City Council; and they had "wet feet."

Creating the learning organization

We all understand the meaning of having "wet feet" because that's where good leadership starts, especially for a water monitoring program. Inga monitored Cypress Creek on Lake Travis with her Westwood High classmates, and Chani monitored Shoal Creek inside the Austin city limits with her LBJ Science Academy friends. Inga and Chani had become close friends through the training activities of our organization and environmental advocacy events. Chani was one year older and an early role model for Inga while speaking out in support of a city-wide ban on phosphates in laundry detergents. Chani campaigned with fellow Science Academy students Sandra Cavazos, Jonah Mesritz, Tamara Saltman, and Kim Stienke. They helped win the campaign and Austin adopted a ban on the sale of detergents with greater than 0.5 percent phosphate content.

The friendship between Inga and Chani grew into an effective partnership that helped bring their two high schools closer together. Students from Westwood and the LBJ Science Academy testified in favor of the Comprehensive Watershed Ordinance which was designed to protect the recharge zone over the Edwards Aquifer and the "heart of Austin," Barton Springs. It was a wonderful, thrilling experience for these young high school students to be part of the "political scene" and feel empowered by adults who listened to their testimony with a respectful attitude. They became responsible adults during those weeks and months. The whole city was involved in the struggle between the land developers and environmentalists. What happened to the students during these stressful days is simply put: "There sure was a whole lot of learning going on." The kind of learning that will stay with those young people throughout their adult lives. The bottom line on learning is, Just Do It! What learning is, in its simplest and purest form, is "being able to do something."

Peter M. Senge calls it "personal mastery" of whatever tasks you have to perform in your business organization. He is giving his advice to corporate leaders who are reading his recent book, *The Fifth Discipline: The Art and Practice of the Learning Organization.* Thoughtful and intentional change is how an organization can remain fresh and vibrant, but not without personal mastery within the organization. Our volunteer monitoring organizations learn through the senses of our monitors out there in the creeks. They're getting their feet wet and our organizations continue changing and improving from those experiences. When personal mastery stops and people stop trying to do new things, our organizations dry up.

Young people want to learn how to function in our society and to be effective doers. But, they are often afraid of making mistakes. Our role as adult leaders is to overcome this initial fear of failure and allow young people a chance to learn from their experiences. The key strategy is to try again. When failure occurs, as it should, get back up and try again.

Opportunities for students

The Colorado River Watch Network offers many opportunities for young people to learn from their mistakes. Change is constant and what is offered here is from our first five years of organizational building.

1. **Annual River Watch Symposium:** Once a year we hold a large gathering of all student monitoring teams at a camping facility where we have plenty of room and solitude.

It's held toward the end of the school year so that monitoring teams have had time to collect sufficient data for analysis. Teams write a technical report and construct a display poster for viewing by other participants. We hang the posters on long clotheslines and give each team five minutes at the microphone to explain their work. Presentations are judged by all participants and awards are given in five different categories. The symposium event is a time to create "heroes" and to recognize student leaders. A traveling trophy is given to the school that has set the highest standard of effort during the year. The "River Watch Warrior" trophy is a prize worth winning and a great thrill for everyone to anticipate and cheer about.

2. **Peer tutoring and mentoring:** The Austin Youth River Watch Program addresses the high school drop-out problem by providing ninth-grade students with peer tutoring from a successful eleventh- or twelfth-grade student. Funded by the City of Austin two years ago, the program has achieved positive results and is expanding. This is an after-school program designed to keep kids off the streets and in the creeks. The student tutors are paid a minimum wage for three hours each week to raise their self-esteem and give them their first real employment opportunity.

3. **Computer networking monitoring teams:** A new partnership with Southwestern Bell and the Texas Environmental Center has brought the Internet resources to the Science Academy. Two other schools are also in the pilot program. A server computer at Rice University stores our monitoring information and links the three schools to each other and to Texas Watch at the Texas Natural Resource Conservation Commission. We are learning how to use the resources of Internet and to build our little "superhighway onramp."

New efforts take time to incubate and hatch. All the eggs won't hatch, but your organization should keep on laying them. The key to success is to start small and grow big gradually.

Opportunities for teachers

I have a lot of empathy for teachers in today's society. They are highly undervalued and overworked. But, so are environmentalists. In fact, I feel wealthy around my environmentalist friends and that's a very unusual feeling for a teacher. You can really find strong allies within the teaching profession. We have a lot in common.

What teachers need today is a connection to the outside world. School activities tend to smother teachers inside their classrooms between September and May. Talk to them during the summer months and find out what education goals you have in common and build your partnership from that point.

Good teachers will feel motivated to learn about their community and to find resources for their students. Your organization can help them on both counts. Set up your training program for teachers and take them out into the watershed. Show them the real world and watch them bloom. Teachers have a basic instinct to gather knowledge and share that wealth with their students. Give them a little equipment to monitor water quality and they will become your slave for life. Nurture this relationship and build new programs on discovered talents. Remember, people make the difference, and every organization should be unique because of the various talents in the group. Copy the best of what's out there and create something new from the rest.

There is another reform movement sweeping science education and you should become aware of its implications for your program. It is called **Project 2061** by James Rutherford and members of the American Association for the Advancement of Science. Rutherford claims the recommended reforms will be done before Haley's Comet returns in 2061, but I'm not sure of that optimism. There are two books out that will help you work with teachers, *Science for All Americans* and *Project 2061 Benchmarks*, both published by the Oxford University Press. The benchmarks are written for specific age groups and include science education content topics for individual mastery. Many of these benchmarks match the intent of environmental education. You can help the teachers and schools in your region of the country develop curriculum and teaching strategies that accomplish the 2061 benchmarks. Wouldn't this be great—reforming education and improving environmental quality at the same time!

Future view

Chani Gilfeather is now a student at the University of Texas in Austin and a member of our Colorado River Watch Foundation Board of Directors. Inga Adams is attending Georgetown University and fully intends to be a foreign diplomat one day. No one doubts her word. Having young people pass through your program and go on to adult responsibilities is the ultimate joy of education. A "learning organization" can help them get where they want to go.

The teachers and citizens of the Colorado River Watch Network are still working hard in Texas and looking forward to the upcoming visit by Vadim Kalinin and his "Waterdrops" of Obninsk College in Russia. He is coming over in the summer of 1995, and 10 of our students will visit his program during the summer of 1994. There are wonderful opportunities out there in the world right now. It's a great time in history to be alive and working for the common good and environmental quality.

Patrick Reese
Friends of the Fox River, Inc.

About Leadership in the Boardroom

Leaders are developed by challenges.
- James E. Burke

My assignment today is to talk about the responsibilities of the board of directors and the important leadership role the

board plays in the environmental organization. Abby Markowitz and Wes Halverson recruited me to address these subjects because I am the founder and former president of a watershed organization. But I'd also like to talk about leadership in general, and begin by sharing part of my own story.

The idea for founding the Friends of the Fox River came to me, a construction worker, while I was fishing from my boat one day in the spring of 1988. I was fishing alone along a tree-lined river corridor in an urban setting. Here I had the wonderful illusion of fishing a forested river in Canada. But during the day my dreamworld was destroyed. A tree surgeon hired by the Kane County Forest Preserve District came by with chain saws and trucks and clear-cut what turned out to be about 300 mature trees along the river's edge, decimating the river's scenic beauty and critically damaging its aquatic habitat and fishery.

The District had developed a new bike trail along this portion of the river, and I later learned that the District's policy was to cut riveredge trees in urban areas so people couldn't hide behind them and mug trail users. Taking a few trees and trimming others might have been a workable compromise, but at the time there was no organization in place to monitor district policy or its management practices.

So from this event the Friends emerged and I became, unwittingly, a leader. And because an organization now exists to monitor environmental conditions in our watershed, many other river advocates, like me, have become educated and active environmental leaders within their communities.

But the formula for creating the Friends wasn't my own. It came from reaching out to the experienced leadership and program models of other organizations. Talking with these leaders enabled me to gain the knowledge I needed to understand environmental issues, develop a vision for our river, and organize a board of directors and our RiverWatch programs. In fact without their guidance and encouragement the Friends might never have, like a mayfly, emerged.

The above story helps illustrate my first observations about leadership: A leader is a person who fully learns the issues, makes the argument honestly, and inspires others to respond and perform. And if an ordinary construction worker or fisherman can become a leader, so can anyone who is awakened to the challenge.

Today, throughout our country, there is an appalling lack of leadership for resolving our nation's socio-environmental problems. And the role and responsibility of the environmental organization is not only to monitor public policy and educate the public about these problems, but to provide citizens with opportunities to become active on issues that concern them. It is from this education and involvement that new leaders emerge.

In fact every person involved in any volunteer organization at every level is a leader, from the program volunteer to the president of the board, because each volunteer provides a still unique example and public service for his or her family, neighbors, and communities.

The role of the board of directors

Often, as Abby and Wes have so eloquently described, program volunteers becomes great, courageous leaders. Yet front-line volunteers are not always aware of the important leadership role of their board of directors—how the board drives organizational success and makes their roles possible. On the other hand, what some board members don't always understand is the importance of becoming a leader more than simply in name.

The challenge of the nonprofit board is to define the issues and empower the program volunteer (or client), and being on the board demands that each board member set an example for the program volunteer by becoming a leader in fact, meaning that directors assume responsibility for the success of their agency and should be willing and able to contribute the time and expertise needed to achieve organizational goals—and be absolutely loyal to its mission.

Occasionally inexperienced nonprofits recruit directors who only attend board meetings, or who have conflicting interests, or whose principal motivation is wielding personal power. These directors short-circuit board work and organizational development goals. To help avoid these problems, perhaps the best standard in recruiting board members is a test of character—determining whether the candidate is a "friend of the human race" or a slave to a personal or special interest. Or, as Havel wrote, discovering if the candidate shares "a deeper sense of responsibility toward the world, which means responsibility toward something higher than himself."

In my experience the effective board leader is first a person who is concerned with achieving social justice—because this, like the civil rights movement, is the underlying or central purpose of the environmental organization. Given this guideline, board members should be unmoved by conflicting special interests and subversive political influences.

Often in the environmental organization many board members have little experience serving on a nonprofit board, but most bring management skills to the board and all have varying degrees of leadership experience. Fortunately there are many levels of leadership ability and areas where leadership is needed, and most any volunteer who accepts the "board challenge" can, with proper training and involvement, become a great leader.

Probably the best way to learn is to become the student of leaders outside of the organization. This means that board members must have initiative. By networking with staff and board leaders from other nonprofits, and researching their successes and failures, board members may expand their knowledge and bring the experience and example of others to their board.

Within many volunteer groups there are three levels of management where leadership is needed. These are: board of directors, staff or program administration, and volunteer management.

The governing board is the permanent part of the organization. The board is the stable, continuing element of the

agency because it provides for its own orderly perpetuation. Staff and volunteers are highly mobile or transient, so the heart of the organization lies in the boardroom, and the success of the agency is measured to a large extent by what the board does and by what it fails to do.

The board—that is, management—has to give direction to the institution it manages. The board's primary responsibilities include: establishing the organization's purpose and mission; setting policies, goals, and objectives; approving programs; engaging in organizational planning, fundraising, financial management, risk management, and public relations; employing a volunteer or paid administrator; and evaluating agency performance. In short, it has to organize resources toward achieving the greatest results.

Program administrators are responsible for program development and delivery, and the recruitment, training, and retention of volunteer group leaders. Volunteer group leaders are responsible for the training and success of the front-line soldiers, the program volunteers, who in turn are responsible for collecting data, educating their communities, and implementing the desired environmental change.

Board committees

The area where board leadership becomes most beneficial is in the operation of board committees. Committee work is crucial to board success, and this work should be organized by the board to accomplish most board work between board meetings. Board committees in particular must have committed and able leaders, and next to being an officer, being a committee chair is the most important responsibility a board leader will ever have. Essentially committee work should be organized to fulfill the board responsibilities listed above.

Board training

Having a well-defined mission, budget, operating plan, and committee structure are essential to providing direction, a sense of unity, and inspiration for successful board work, and the climate needed for leadership to emerge. Given this management framework, providing organizational development and leadership training are the next steps.

Developing an orientation packet or manual specific to your organization is helpful in recruiting and training new board members. Additionally, board members should receive professional education materials to help guide them. Two helpful resources are the *Nonprofit Management Notebook 1990*, published by the Beatrice Foundation (402-595-4158), and River Network's *Capturing the Magic of the Board* (800-423-6747).

Planned board orientation, organizational development, or leadership training workshops and retreats are vital to success, because they build consensus and help the emerging board leader develop problem-solving and leadership skills. The Executive Service Corps, which operates in some major markets, the Environmental Support Center in Washington, DC, or community or regional foundations can usually help organize and fund these workshops.

Experienced board leaders, executives from area corporations, and leaders from other nonprofit groups will often volunteer to design and conduct training workshops for you. Also board members should attend most, if not all, of the organization's events, and be willing to attend a number of industry seminars, and even board meetings and training workshops of other nonprofit organizations.

A pitfall to avoid

In terms of recruiting new board members, orientation training should not begin after a new board member has been appointed or elected. It should begin well before the candidate accepts the job, and include: (1) participating in several board and committee meetings, because the new board member must clearly understand what their board responsibilities will be, and (2) "getting their feet wet," because the board member must be in tune with the program volunteer and clearly understand their expectations and needs.

The essence of leadership

I'd like to touch upon what I consider to be the most important characteristic of leadership—moral courage, tempered not with ambition but with truth and justice. To understand this aspect of leadership, what Abraham Lincoln called duty, I feel that nonprofit leaders should become intimately familiar with the vision, work and sacrifices of the great leaders of the past such as Socrates, Joan of Arc, Martin Luther, Lincoln, Lawrence of Arabia, Susan B. Anthony, and Mahatma Gandhi.

Here it is important for the board leader to evaluate four realities: (1) that democracy is not a matter of faith, but a matter of legal guarantees, (2) that the ultimate goal of the environmental organization is achieving an environmentally sound economy, (3) that protecting or restoring environmental quality is not a private interest, but a broad public interest, and (4) that many special interests, motivated by greed, work daily to corrupt the public interest—our nation's leadership, laws, and democratic processes—for private advantage or economic gain. The result is a fake democracy: evasive thinking, hollow laws, and a deceived citizenry.

Conclusion

I'd like to close by recommending that every board leader read about the corruption of leadership and democracy in America. I sense that the most instructive book that any nonprofit leader could read today is William Greider's *Who Will Tell the People*. From this compelling book environmental leaders will gain a better understanding about the betrayal of American democracy and how important their leadership is to the success of their organization, community, state, nation, and world.

In the final analysis, it seems to me, the healing of our environment lies in the healing of its people via restoring an honest leadership and democracy in America. And the beauty of the environmental organization is that it hopes to help achieve these goals—from the grassroots.

Plenary Session, Day Three

Dr. Stan Gregory
Oregon State University, Department of Fish and Wildlife

The Willamette River: Ecosystem Management and Restoration

The management, monitoring, evaluation, and restoration of our resources represent a major public challenge that is generally referred to by such terms as "ecosystem management," "watershed management," "fisheries management," or "riparian management." But in many ways the real challenge gets lost in these terms, because they all describe the easy part.

The real challenge ahead of us is *"human behavior management."* That's the tough part. That's where monitoring comes in, because monitoring is where people gain knowledge.

John McPhee noted that humans tend to think in terms of five generations: two in the past, two in the future, and a heavy concentration on the one in the middle. I think that's an accurate representation. It also sets the stage for monitoring and restoration of a system as complex as the Willamette River basin: a look to the past to consider the history; a look to the present to evaluate its current status; and a look to the future to examine our options and make plans ahead of time.

History of the Willamette

Citizen groups do a tremendous amount to help with historical research. They can scour historical libraries for photos and maps. If nothing else, they can conduct a "geezer survey." Long-time residents have knowledge that we can use.

Looking at old maps of the Willamette valley, we can see where the prairies were. Studying Native American uses of the resources give us more clues about what the river was like historically. The Chinook Indians maintained a major salmon fishery at the falls at Oregon City.

Old photographs can give us an image of the vegetation at the turn of the century. Photos of canneries give us an idea of the impacts we've had on the fisheries.

Early accounts of the river boats on the Willamette indicate that the crews spent more of the time off the boat cutting down riparian vegetation and clearing snags than they did actually running the boat. Probably the term "logger" was more appropriate than "river boat crew member." The river was also used to transport logs—and you can imagine what this does to the habitat and the resources.

Historical documents like maps and photographs give us a sense not only of the change that has occurred, but of the potential for the future—the kinds of things that might be possible if we change some of our practices, and set standards and goals now.

Along the Willamette there have been many changes. Much of the riparian zone and floodplain has been converted and put to different kinds of land uses—urban, agricultural, industrial—greatly diminishing the ecological capacity of the river. Now we try to have "hard" engineering solutions, when the natural system provided a natural filter along the river, a natural buffer against floods.

We channelize the river, turn it into a pipe, dump things into it, and then wonder why we have to spend millions and millions of dollars maintaining water quality.

The present and the future

If you think our challenges are tough today, think about 25 to 30 years from now. The population in the Willamette valley will probably be double what it is now.

But we haven't lost the Willamette River. All we have to do is take a look at what we're doing. We can restore the river if we want to. What are some of the ways we can involve citizens?

Go out and measure anything. We need information, and we need to have people get to know the resource. The most effective way to educate the public is to let them know what their world is like, and one way to do that is to let them measure it. What they measure could be the insects, it could be the fish, it could be the birds, it could be the habitat. In terms of habitat quality, we're way down in the red zone. I know of no study of habitat quality in the Pacific Northwest that has concluded that it's in good condition.

One thing volunteers can do is capture an image. Go out in a boat and take a video— once a month, once a season, once a year. I guarantee you, 100 years from now people will want to see that image. Think what you would give for a video of the Willamette River in the 1850s.

Restoration is going to take at least 100 years. It takes these systems time to heal. But it will never happen unless we start today.

Using Your Data to Evaluate Your Volunteer Monitoring Program

Moderator: **Patricia Hurley,** Alabama Department of Environmental Management
Presenters: **Abby Markowitz,** Maryland Save Our Streams; **Janice Miller,** Unified Sewerage Agency; **Mike Mullen,** Troy State University, Alabama; **Deborah Dahling,** Bellevue Utilities Department

Abby Markowitz
Maryland Save Our Streams

How SOS Used Data Evaluation to Identify and Solve a Problem

In 1990, Maryland Save Our Streams (SOS) implemented "Project Heartbeat," a volunteer bioassessment program modelled on Protocol 2 of the EPA's guidance document, *Rapid Bioassessment Protocols for Use in Streams and Rivers: Macroinvertebrates and Fish* (1989). Heartbeat was piloted in Baltimore County, under the local name "100 Points of Stream Monitoring." Volunteers were trained to conduct macroinvertebrate and habitat assessments on 100 stations along the county's waterways in the spring, summer, and fall. SOS organized both a volunteer Steering Committee made up of community leaders, educators, students, and interested volunteers and a Technical Advisory Committee comprised of biologists from agencies and universities to help oversee and direct the program.

After the first year of sampling, we began to take a look at the data as a tool for evaluating the effectiveness of the training and the program. This process has been continuous throughout Heartbeat's five-year history. What I'd like to do is illustrate this process through a specific example in which we used data to evaluate, refine, and improve the monitoring program. Our evaluation process followed these four overall steps (keep in mind that many steps overlap or are continuous):

1. Identify problem.
2. Explore possible reasons for problem.
3. Develop and implement strategies for correcting the problem.
4. Analyze results; if problem was not corrected, go back to step 1.

1. Identifying the problem

In order to analyze and interpret data, Heartbeat macroinvertebrate subsamples should contain at least 100 organisms. After the first two sampling seasons, we observed many samples with fewer than 100 organisms. Further, many samples did not contain any "midges," a family of dipteran that should be found in every sample. Midges are tiny, hairlike critters that are easy for the nonprofessional eye to miss. We determined that volunteers were having trouble spotting and picking small organisms—including midges. We were able to detect this problem through field data forms, macroinvertebrate tally sheets from each lab session, written volunteer evaluations, and Steering Committee discussions among themselves and with other volunteers. Once we identified the problem, we began to explore the possible reasons.

2. Possible reasons for problem:

- collecting and sorting organisms difficult in urbanized streams due to overall small size and sparsity of critters
- sampling equipment not adequate for seeing and picking up small critters
- importance of 100+ sample size not emphasized enough in training
- training in selecting optimum sampling area not adequate
- training in macroinvertebrate field ID not adequate—people not looking for small critters
- some volunteers impatient with length of time required to collect adequate sample and/or with discomfort of prolonged kneeling to collect critters off the net

This exercise showed us that many of our problems seemed to be related to training emphasis and methods. In addition, we realized that we needed more sensitive equipment (forceps, magnifying lenses, etc.). We also determined that sampling procedures and protocols required some revision. Our next task was to come up with ways to alleviate these problems.

3. Taking action to correct problem

- grant written and received for improved equipment—forceps, magnifying lenses, etc.; other new equipment added to aid in collection and sorting—including holding buckets and spray bottles
- training and data forms restructured to emphasize significance of 100+ sample; preregistration materials designed to advise volunteers to bring knee cushions, dress for sitting on the ground, etc.
- Steering Committee members and staff produced hand-drawn color maps of each station, detailing exact location of riffle(s) to be sampled; maps were color-copied and placed in station field packets for each monitoring team
- composite sampling introduced at all sites; volunteers instructed to sample three times, in different sections of the riffle, at each station, and to composite results of each sample before subsampling
- experienced volunteers recruited to be team captains; team captain training introduced as a separate event

These measures were developed and implemented over time through trial and error. It was critical for us to continually evaluate the strengths and weaknesses of each strategy and to be flexible enough to recognize when we needed to change strategies.

4. Analyzing the results

As the following charts demonstrate, this evaluation process has been successful for us over the last few years. Figure 1 (below) illustrates the increase in midges collected by volunteers over the year. In 1990, only about 65 percent of samples contained midges. By the summer of 1993, 99 percent of all samples contained midges.

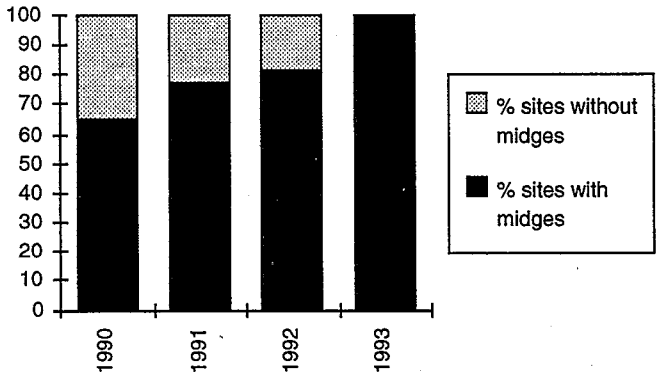

Figure 1. *Increase in midges collected by volunteers, 1990 – 1993.*

Figure 2 (below) shows the increase over the seasons of samples containing 100 or more organisms. Over the last several years, we have gone from 25 percent of samples with an adequate subsample size to about 80 percent. However, the spring of 1993 shows a significant drop, which we believe is due to unusually late snows with slow melting and very heavy rains.

Figure 3 (above right) looks at one particular watershed, Bird River. Bird River is a highly urbanized watershed where

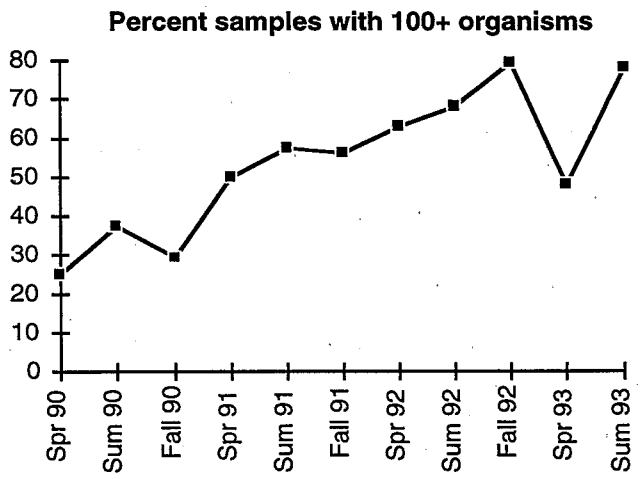

Figure 2. *Increase in samples with 100+ organisms.*

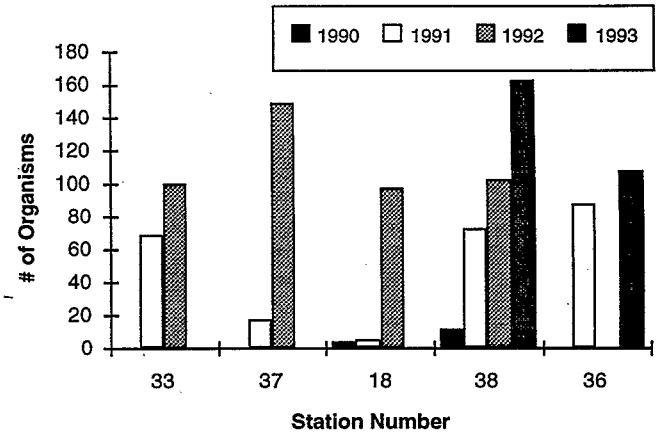

Figure 3. *Number of organisms collected from Bird River stations.*

volunteers have historically had a difficult time collecting an adequate subsample. This chart traces the progress, over the summer seasons, of volunteer ability to collect 100+ organisms. (If a season's data are not shown, this indicates that the station was not sampled that season.) It is important to note that the numbers of organisms subsampled in both urban and rural watersheds increased over the 11 sampling seasons, with the exception of spring 1993. In addition, volunteer time in the field did not significantly increase—in fact, it actually decreased in some areas.

Janice K. "Jan" Miller

Unified Sewerage Agency

Chemistry Data

I. Compare your data

A. Try to find some other data with which to compare your data.
   1. Split your samples with a professional lab doing the same tests on similar samples.
   2. Find data from other reliable sources on similar streams in your area.
      a. Look at the range of values they get and compare them with yours.
      b. If they don't have the same parameters, are similar parameters showing the same pattern?

B. What are the Water Quality Standards for the stream.
   1. If your data suggests the stream is out of compliance, does that match what you would expect?
   2. Do all the parameters give the same pattern or is there an explanation when they don't?
   3. Are the values so far below the Water Quality Standards that you don't have to worry about how "tight" the data are?

C. Compare to other sites that your organization monitors.

II. What constitutes a good match

A. Duplicates for one sample by the same analyst in the ± 5 – 10 percent range are good, if you are in the middle of the test range.

B. Duplicates between labs on the same sample in the ± 10 – 20 percent range are good, if you are in the middle of the test range.

III. What to do when they don't match

A. Review and double-check all calculations.
   1. Was there enough information recorded by the volunteer to do this?
   2. If they ran the test more than once, how consistent were their results?

B. Are you reporting the same thing?
   1. Phosphorus as P vs. Phosphate (PO_4)
      [$0.33 \times PO_4 = P$]
   2. Ammonia as N vs. Ammonia (NH_3)
      [$0.83 \times NH_3 = N$]
   3. Nitrate as N vs. Nitrate (NO_3)
      [$0.23 \times NO_3 = N$]
   4. Temperature in Celsius or Fahrenheit

C. Whose values are more realistic?
   1. pH should be less than 14.
   2. DO should be less than 20, but any data over 12 should be checked out.

D. Could there have been a problem with your glassware, or water?
   1. Total phosphorus glassware needs to be washed with phosphate-free detergent and rinsed with hot dilute HC1.

E. Check storage and handling requirements if the test wasn't done in the field.

F. Was the procedure you were using appropriate for the test? Did it give reliable results in the range of most of the samples?
   1. Did the volunteer have enough information to do the text properly?
   2. Is there a consistent pattern?
      a. Do experienced people do better than novices?
      b. Do samples taken at the same time of day match better than those that are not?
   3. At the bottom end of the test range you can expect variations greater than 30 percent with everything else being done very well.
      a. If the test range is 0.02 to 1.0 mg/l, you can expect 3 percent variation between 0.02 and 0.04 mg/l. If you can it is a good idea to report these results as estimates.

Mike Mullen
Troy State University

Resolving Data Discrepancies

Problem:

Dissolved oxygen (DO) data from three volunteers sampling the same area of a well-mixed nutrient-poor lake are unexpectedly different and, in the case of one volunteer, somewhat erratic.

DO DATA (mg/l):

Date	John	Jane	Joe
1/15/93	10.0	9.9	8.5
1/31/93	10.2	8.7	8.6
2/14/93	10.1	8.8	8.6
2/28/93	10.4	10.3	8.7
3/14/93	10.0	10.1	8.5
3/28/93	9.8	8.6	8.3
4/14/93	9.7	8.0	8.2
4/28/93	9.8	8.3	8.1
5/14/93	9.4	7.9	8.0
5/28/93	8.7	8.9	7.3
6/14/93	8.6	7.6	7.5
6/28/93	8.5	7.2	7.0
7/14/93	8.4	6.9	7.0
7/28/93	8.3	8.1	6.9
8/14/93	8.5	8.3	7.0
8/28/93	8.1	7.1	6.9
9/14/93	8.6	7.2	7.3
9/28/93	8.8	8.5	7.4
10/14/93	9.1	8.8	7.8
10/28/93	9.4	8.3	8.1
11/14/93	8.9	7.6	7.7
11/28/93	9.4	9.1	8.2
12/14/93	9.7	9.9	8.4
12/28/93	9.6	8.5	8.3
AVERAGE	9.3	8.4	7.9
HIGH	10.4	10.3	8.7
LOW	8.1	7.1	6.9

Questions:

1. What are some possible reasons for the difference in the dissolved oxygen data collected by John and by Joe? How might you determine why the two sets of data are different? What are some possible corrective actions for solving the possible problems you identified?

2. Compared to the data from John and Joe, Jane's data seems to be much more erratic. Other than poor technique, what are some possible causes for the variability in Jane's data? What are possible corrective actions for the problems? What other parameters might provide help?

Probable causes of the data discrepancies:

1. John's data vs. Joe's data. There are several possible explanations for the differences in the data collected by John and Joe. Since the two sets of data track each other, it is possible that there is a systematic error in the procedure. One of their test kits could have had titrant for DO that was significantly weaker or stronger than it should have been. The magnitude of the difference makes it unlikely that it was caused by a systematic error in the titration.

Another possible cause of the difference in the data could be a difference in sampling time. If Joe sampled in the morning just before going to work and John sampled in the afternoon after getting off work, the differences could be explained by diel variations in DO.

Finally, it is possible that sampling at different depths caused the differences in John and Joe's data.

2. Jane's data. Jane's DO data are highly variable. A reasonable conclusion is that Jane might be having problems collecting samples. She might be introducing error due to poor sampling technique or might not be careful enough when titrating. On the other hand, Jane might be doing everything correctly. The data variability could result from taking DO samples at different times of day or at different water depths.

Possible solutions:

The problem of "bad" reagents can be addressed in several ways. Volunteers can be encouraged to buddy up with another volunteer for the purpose of simultaneously sampling and checking results. Technical assistance personnel can conduct "field audits" in which they go into the field and collect samples and test side by side with volunteers. When received, reagents can be dated and the expiration date noted. Fresh reagents need to be supplied in a timely manner to assure that old, outdated reagents are not used.

The necessity of sampling during the same time period and at common depths can be stressed during training and retraining activities. DO sampling in lakes should include temperature (or conductivity, etc.) profiling to assure that samples are taken from the well-mixed zone (epilimnion). Volunteers testing within the same area of a water body should strive to test at approximately the same times (days and times) to yield data with the greatest value for trend monitoring and planning.

Deborah A. Dahling

Stream Team Coordinator, City of Bellevue, Washington

Volunteers Help Monitor the Effects of a Lake Restoration Project

In 1993, Bellevue's Stream Team volunteers were called upon to help monitor two small lakes following a major city-sponsored restoration project. The two lakes, Phantom and Larsen, have highly urbanized watersheds and during the late 1980s began to experience more frequent and severe algal blooms. The restoration project addressed inputs of nutrients, primarily phosphorus, into the lakes. Volunteers are important in monitoring water clarity and conditions to address the release of phosphorus from lake bottom sediments.

From both lakes, volunteers collect water temperature and dissolved oxygen concentration data at different water depths. Water temperature is monitored to detect the onset of lake stratification. Once a lake stratifies, oxygen is depleted more quickly in the colder, deeper water layer. If the dissolved oxygen concentration falls below 2 mg/L, phosphorus is released from the sediments and is available to growing algae. As part of the restoration project, aerators were installed to oxygenate the deeper water layer when the lakes are stratified. Volunteer data are used to show the onset and breakdown of stratification so city staff know when to turn the aerators on and off. The dissolved oxygen measurements collected by the volunteers track the efficiency of the aerators in keeping dissolved oxygen concentrations above 2 mg/L in the lakes' deeper waters.

Volunteers also collect Secchi disk measurements on both lakes. Taking Secchi disk measurements is an indirect way of monitoring the amount of algae in the water. In designing the restoration project, water clarity goals were defined in terms of Secchi disk measurements—0.9 m for Larsen Lake and 2.7 m for Phantom Lake. The volunteer data provide water clarity trend information following restoration measures and points of reference regarding water clarity goals.

Following the first year of monitoring, city staff and volunteers evaluated the program to address data quality concerns. The lessons learned included:

• **Larsen Lake.** The monitoring site at Larsen Lake is on the end of a pier extending from the lake's edge. By looking at the data we began to see that during most of the year the Secchi disk hit the bottom of the lake before disappearing from view. Therefore we were not getting an accurate Secchi disk reading for establishing trend information or comparing to restoration water clarity goals.

Additionally, the water at the monitoring site was not deep enough for volunteers to detect the changes of water temperature which indicate stratification. Consequently, the volunteer data was not identifying the aerator operation window for city staff. Volunteers also could not detect whether the aerator was keeping dissolved oxygen concentrations above 2 mg/L in the deeper sections of the lake. Since this is a monitoring location problem, we are currently considering other location options.

• **Phantom Lake.** About six months into the program, the volunteers began recording very low dissolved oxygen concentrations near the bottom of the lake. We assumed the lake was not stratified since volunteers were recording homogenous temperatures from the water surface to bottom. Homogenous temperatures suggest lake turnover or mixing, so

dissolved oxygen concentrations should be over 2 mg/L and consistent from top to bottom. Due to the low dissolved oxygen measurements, city staff monitoring trips were organized to verify the volunteer results. Staff measurements indicated that oxygen concentrations were at acceptable levels. However, the temperature measurements were correct. This information led city staff to determine that the aerator was inducing lake mixing and heightening nuisance algal blooms. The aerator has since been adjusted to prevent this from happening. The problems encountered with the data accuracy regarding dissolved oxygen measurements most probably lie in training issues and equipment management. City staff and volunteers are working together to address data quality concerns.

Bacteria Testing, Part Two

Moderator: **Esperanza Stancioff,** University of Maine Cooperative Extension
Presenters: **Marie Levesque Cauduto,** Connecticut River Watch; **Mary Gilroy,** Lower Colorado River Authority; **Debra Wirkman,** Surfriders

Marie Levesque Caduto
Connecticut River Watch Program

Membrane Filtration for *E. coli*

What is *E. coli?*

Escherichia coli (E. coli) is a species of fecal coliform bacteria that occurs in the gastrointestinal tract of warm-blooded animals. It occurs in high densities in human wastes and has been used as an indicator of fecal contamination for many years. It does not grow in the natural environment under ordinary circumstances. Studies have shown a close correlation between high *E. coli* counts and the incidence of gastroenteritis (digestive tract illness) at swimming areas (U.S. EPA, 1986). Most *E. coli* are not disease-causing bacteria, but their presence signals the possible presence of viruses and other disease-causing microorganisms.

What is CRWP?

Connecticut River Watch Program (CRWP) is a volunteer monitoring, improvement, and protection program for the Connecticut River and tributaries in Vermont and New Hampshire. We monitor over 100 sites on 12 to 18 different waterways, from large rivers to tiny streams. We monitor for *E. coli*, total phosphorus, turbidity, and temperature five times over the summer (usually July - August, when the water is most heavily contacted).

All our lab work is done in donated labs (most recently, labs at the local technical college and the Army Corps of Engineers) by minimally paid lab coordinators. We provide major equipment, such as incubators, and all reagents, and the lab provides space, hot plates, balances, distilled water, etc.

Why did we choose the *E. coli* method?

One major focus of CRWP and other River Watch Network programs is to ensure that the data we gather is scientifically credible. EPA's 1986 study of different bacteria indicators found that both *E. coli* and enterococcus gave good correlation to illness in fresh water. (In saltwater, enterococcus is recommended.) *E coli* is easier to test than enterococcus and is used by both New Hampshire and Vermont in their state standards. We want to ensure that our data are used to the greatest extent possible and have the greatest impact possible, so *E. coli* is what we use also.

Quality assurance and data use

We follow EPA-approved procedures with very slight adaptations for non-certified labs (such as allowing pressure-cooker-type autoclaves to be used). To establish and maintain our credibility, we perform QA/QC procedures such as splitting samples with state labs, splitting samples between our own labs, running blanks and state-prepared unknowns, and duplicating samples within each lab. Because of this our data has been accepted and used by both Vermont and New Hampshire in their 305(b) reports. So far they have qualified our data as "evaluated" rather than "monitored," but we're working on having the data accepted as "monitored."

Currently an extensive bistate water quality assessment is being done on the Connecticut River, and our data are part of it. We feel this is a major endorsement of our work. Unfortunately the two states have different numerical water quality standards for *E. coli*—Vermont uses 77/100 ml in a single sample, while New Hampshire uses the geometric mean of 126 in 3 samples or 406 in a single sample. Because the Connecticut River is officially in the state of New Hampshire, we use the 126 GeoMean, then use state standards on the tributaries.

Summary of method:

1. Water sample is collected in a sterile "Whirl-pak" bag. Samples should be analyzed within 6 hours.
2. A subsample is pulled through a gridded membrane filter, which retains the bacteria and other particles larger than 0.45 microns.
3. After filtration, the membrane containing the bacterial cells is placed on a nutrient medium, "mTEC," which promotes the growth of *E. coli* colonies.
4. The filter is incubated at 35°C for 2 hours (to resuscitate injured or stressed bacteria), then incubated at 44.5°C for 22 hours.
5. Following incubation, the filter is transferred to a filter pad saturated with urea substrate, which brings out the color of *E. coli* colonies.
6. After 15 minutes, yellow or yellow-brown colonies are counted.

Both the formulation of the "mTEC" nutrient medium and the relatively high incubation temperature encourage the growth of *E. coli* bacteria and inhibit the growth of other bacteria. Incubation for two hours at 35°C increases the survival rate of *E. coli* bacteria by reviving injured bacteria prior to the high temperature incubation. The incubation at 44.5°C favors the high-temperature-tolerant *E. coli* over other bacteria types.

The *E. coli* break down an ingredient in the medium and produce acid, which causes the dyes in the nutrient medium to produce a yellow color. Other bacteria do not produce the acid and remain purple in color. Placing the incubated filters on the urea substrate at a pH of 4.5 selects for *E. coli*. Other bacteria types break down the urea and turn the colonies alkaline, which reacts with the dye in the substrate and causes

them to become red or purple. The *E. coli* colonies remain yellow because they cannot break down the urea and so remain acidic.

Advantages and disadvantages

Disadvantages of using this method in a volunteer program include:

1. The initial expense of equipment, which can run up to $3,700 if incubators are needed.
2. Time-consuming preparation (making and pouring media plates, preparing buffered rinse water solutions and urea solution).
3. Difficulties in getting all samples run within the 6-hour time limit from collection.

However, the advantages do outweigh the difficulties. The numbers are acceptable by and comparable to both state agencies, making this a key test in our area. Also, once the lab is set up volunteers can easily be trained to run the samples. After a bit of practice, they can do the test on their own.

Reference

Ambient Water Quality Criteria for Bacteria. 1986. EPA 440/5-84-002. Office of Science and Technology (4304), 401 M St., SW, Washington, DC 20460.

Mary P. Gilroy

Lower Colorado River Authority

Fecal Coliform Test: Equipment and Information

The Colorado River Watch Network (CRWN) is an environmental education and data collection program involving volunteers throughout the lower Colorado River Basin. We are part of the Lower Colorado River Authority (LCRA), a self-supporting public utility created by the Texas Legislature in 1934. The Network has grown from a handful of Austin high school students in 1988 to an estimated 500 participants. Monitors test weekly for dissolved oxygen, pH, TDS, nitrate-nitrogen, orthophosphorus, and fecal coliform bacteria, and many are now being trained in biological monitoring techniques. Many of our monitors work on urban creeks in the Austin area, where fecal contamination from NPS runoff or sewage can be a problem.

Why does CRWN use fecal coliform testing?

All of CRWN's tests were chosen to complement LCRA's professional monitoring efforts, as well as to promote water quality protection. We chose fecal coliforms as our bacterial test organisms because the state regulatory agency and LCRA use fecal coliforms as an indicator for surface water. Standards are based on the geometric mean of five samples over 30 days.

Why did we choose the membrane filtration method?

Both the size of our network and its volunteer nature contributed to our choice of the membrane filtration method. We needed to choose a test method that was relatively simple and low cost, while still being able to give accurate counts of fecal colonies. Another consideration was availability of laboratory facilities—since the network stretches over 600 river miles, and many monitors live in rural areas, it was not economically or logistically feasible to contract with a lab for sample analysis. The low-tech membrane filtration method provides a low-cost, easy-to-use alternative.

How is our method different from standard methods?

LCRA's lab and CRWN use similar filtration apparatus and procedures, with minor differences in connections and type of vacuum pump. Differences are more apparent in sterilization and incubation methods. Monitors do not have access to autoclaves, so sterilization involves allowing equipment to dry out between samples (usually one week or more), then rinsing equipment with alcohol and excess deionized water.

For incubation, CRWN monitors use a water bath incubator made from a simple Igloo cooler equipped with an aquarium pump and heater. The incubator must be set up a few days prior to the testing so that the temperature can be adjusted to the necessary 44.5°C. Many monitors keep the incubator running constantly to minimize temperature variations.

Detailed instructions for constructing incubators, as well as instructions for CRWN's membrane filtration method, are available from Lower Colorado River Authority, P.O. Box 220, H-202, Austin, TX 78767-0220; telephone 1-800-776-5272, ext 7634.

How good are the results?

Side-by-side tests were run with a CRWN monitor using our equipment and the LCRA lab using standard laboratory procedures. A sterile one-liter container was used to sample from a creek, and mixed well before subsampling. Five subsamples were poured into standard 125-ml sterile sample bottles for LCRA lab analysis. The remaining sample was subsampled and analyzed using CRWN techniques and equipment. The results were encouraging: a t-test analysis showed no significant difference between the sets of numbers. We plan to expand this side-by-side testing in the future, with an increased number of data points for the statistical analysis.

Experience with this method

This method is more time-consuming than simply collecting samples for lab analysis. Many monitors are not able to commit to the approximately 30 minutes it takes to run the tests and count the plates the next day.

Quality control is another issue. If the incubator is not maintained at 44.5°C (± 0.2°C), other types of organisms can grow on the medium. The colonies produced by these organ-

isms will not have the blue color characteristic of fecal coliform colonies, and monitors are instructed not to count colonies unless they are blue or partially blue. However, this is a judgment call that can introduce inaccuracy into the values.

Monitors are instructed to count all colonies they can see distinctly and are told that the optimum number of colonies per plate is 60-80. If more than 200 colonies are counted, they are to report it as "TMTC" (too many to count). This is a helpful indication that they should run a greater dilution with the next sampling time.

Another potential problem is with cross-contamination. CRWN takes several steps to avoid this problem. As described above, monitors sterilize the filtering apparatus with alcohol and rinse well with deionized water. The highest dilution is always run first, with multiple rinses with deionized water between dilutions. Blanks are run at the end of each sample run; if these are not completely free of colonies, monitors are instructed to discard any data from that sample run.

Use of the data

CRWN monitors are able to use fecal coliform tests to identify trouble spots that can then be verified by LCRA professionals. Elevated fecal counts from two CRWN sites were used to identify leaking sewage lines that are now slated for repair. Another monitor's data is used to help determine the swimming status of a creek in a state park.

Because the CRWN fecal testing is used for screening purposes and 'trouble spots' are verified by professionals, we find that this system works well. Using a low-tech filtration apparatus in combination with the homemade water bath incubator provides our monitors with an accessible, affordable, yet still reasonably accurate method of fecal coliform testing.

Debra Wirkman

Surfrider Foundation

Bacteria Testing Methods Used by Surfriders

Who are the Surfriders?

The Surfrider Foundation is a nonprofit organization dedicated to the preservation of the world's waves and beaches through research, conservation, education, and local activism. The organization was founded in 1984 by a handful of surfers who were tired of simply watching and grumbling as their treasured surf breaks became trashed, were suddenly posted "NO TRESPASSING," or—worst of all—were destroyed forever to make way for new harbors, highways, and breakwaters.

The Santa Cruz Chapter of Surfrider was founded in the summer of 1991, and we've been working hard to preserve and improve our part of the Monterey Bay ever since. After all, we have a lot to protect. Surfing is a way of life in Santa Cruz, with its own local culture and heritage.

Unfortunately, there are also some problems. It rains seasonally here, most streams flow intermittently, and drought years are common, so our stormwater often carries a large accumulation of nonpoint source pollutants directly to the ocean via storm drains. On some beaches, huge storm drains stand watch above the waves like enemy gargoyles ready to spew nasties on unsuspecting surfers; regulars complain of frequent surfing-related sinus infections, flu-like symptoms, and rashes.

Bacterial testing

Phase 1: Coli-Count Sampler

Water quality assessment has been a high priority for us ever since our chapter's kick-off meeting. As soon as the national Surfrider office made the Millipore Coli-Count Sampler tests available, our chapter purchased them. We were also lucky enough to obtain a working incubator from a local donor.

With these supplies, and several sterile sampling bottles provided each week by a local donor, our chapter set up shop in a corner of a member's art studio. Then, with no water quality monitoring experience and no more training than a photocopied sheet of directions could offer, our intrepid members began collecting samples by boat using the Coli-Count Sampler.

The Coli-Count Sampler is supposed to work something like the more sophisticated membrane filtration analysis. A small paddle is dipped into the sample for 30 seconds, shaken off, and reinserted into a case. It is then left face down in an incubator for 24 hours at 35°C. To score the test, the shiny, blue raised dots that have grown on the paddle's grid are counted, and the count is multiplied by 100 to obtain the total coliform count.

Unfortunately, many different colored colonies grew on the grid, and it was hard for volunteers to tell them apart. Also, a lot of error is associated with small variations in the 30-second dipping time. Consequently, our chapter soon gave up on this method.

Phase 2: Multiple tube fermentation

National Surfrider received complaints about the Coli-Count Sampler from many members along the U.S. coast. Eventually, they decided to try another method for total coliform—multiple tube fermentation (MTF), a much more involved procedure. To keep things relatively simple, they recommended using pre-mixed, pre-sterilized test kits manufactured by Hach, and made the test kits available to the chapters.

Our chapter purchased several kits from the national office, but problems quickly became apparent. Some experience in microbiology is definitely necessary to set up a procedure for this test from square one.

The most important piece of equipment we didn't have was an autoclave. Fortunately, we didn't have to worry about

sterilizing our testing equipment. We were able to purchase pre-sterilized inoculation supplies and even pre-mixed, sterile, 90-ml portions of buffered dilution water, although these products are very expensive.

The most probable number index (MPN) is a statistical estimate of the number of bacteria in a sample, based on macroscopic observations of a series of test tubes. A positive tube is one in which the growth media, or broth, becomes cloudy and in which a gas bubble has been trapped in a tiny, inverted vial inside the tube. These conditions must be observed within 48 (± 4) hours.

Next, a loopful of the broth from each positive tube is transferred to a second type of broth (Brilliant Green Bile). If the same observations are made within 48 hours in this broth, the presence of coliform is confirmed.

As you can see, this test was very time-consuming—it took 4 days to complete it, and at a cost of about $1.00 per test tube plus the other supplies, it was very expensive to do it properly. Still, we went ahead and gave it the old eco-warrior try, mainly because this dinosaur of a method was still being used by our local municipal public health laboratories to test ocean water.

MPN tests can be more cost-effective for a volunteer lab if reusable supplies and bulk media are used, but then the need for equipment (or donated lab facilities) and labor skyrockets.

Phase 3: Colilert

By this time, we knew we wanted more specific information about the water we surf in than an estimate of total coliform. Because total coliform bacteria are ubiquitous in the marine environment (sources include rotting kelp, sediments, fish, and mammals), the total coliform test does not specifically indicate the presence of potentially unhealthy fecal contamination.

The year 1993 had arrived, and so had a major change in microbiological water quality monitoring. The EPA had just approved the use of a new test for determining *E. coli* in fresh water and finished drinking water: the Colilert method (Idexx Laboratories). This method combines two tests in one: total coliform and *E. coli* (*E. coli* is a species of coliform). Both are determined in the same test tube within 24 hours.

The Colilert method relies on two target-specific indicator-nutrient compounds that produce a signal when the nutrient is metabolized. The indicator-nutrient ONPG yields a yellow color when metabolized by members of the total coliform group, and the indicator-nutrient MUG yields fluorescence at 366 nm when metabolized by *E. coli*.

Although Colilert has not yet been approved by the EPA for marine waters, there is a specially formulated marine version available. We did comparison studies, both with our previous method and with split samples run at the county lab using membrane filtration for *E. coli*. Results compared favorably—well within the expected variability of the methods.

Samples are collected in sterile Whirlpak bags from an incoming wave, about 6 inches below the water surface. Samples are chilled on blue ice or refrigerated at 4°C until analysis. In the lab, we run five tubes at the 100X dilution for our regular weekly sampling (10- or 15-tube tests are run to double-check problem areas whenever funds allow).

After the tubes are incubated for twenty-four hours at 35 ±0.5 °C, we score the tests. Using a comparator tube supplied by the manufacturer, we record a plus for each tube that's at least as yellow as the comparator. This is the total coliform portion of the test. Then we darken the room and check for fluorescence using a long-wave UV lamp. (Check your local lighting store for an inexpensive one. Be sure to avoid looking directly at the lamp when it's on.)

For quality control checks, we use *E. coli* (positive for both color and fluorescence), *Klebsiella pneumoniae* (color only, no fluorescence), and *Pseudomonas aeruginosa* (negative for both color and fluorescence). We currently obtain these quality control organisms from the county lab.*

Use of the data

We record our weekly water quality results and the county's weekly data on our hotline. We also report high bacteria counts to the County Office of Environmental Health, so they can do followup sampling (sometimes).

Our data gave us the confidence to fight and win a major victory against the city of Santa Cruz. The Regional Water Quality Control Board recently forced the city to apply for the first stormwater permit in our region. The board also ordered that the outfall be clearly posted with permanent warning signs.

**Our complete Colilert method is available on request. Write to Surfrider Foundation, Santa Cruz Chapter, Box 3203, Santa Cruz, CA 95063; or to Debra Wirkman, 1133 Callas Lane #2, Capitola, CA 95010.*

The Watershed Approach

Moderator: **Alice Bamberger,** Westchester Land Trust
Presenters: **Alice Bamberger; Anna Dunbar,** City of Sugar Land; **Dodd Galbreath,** Tennessee State Planning Office; **Elbert Moore,** U.S. EPA Region 10; **Jill Davis,** Kootenai River Network

Workshop Summary

The "Watershed Approach" workshop was designed as a discussion session for watershed leaders in the audience and on the panel. Following brief introductory remarks by the panel moderator, Alice Bamberger, panelists and audience participated in a brainstorming session to identify the strengths and challenges of the watershed approach. Based on these strengths and challenges, guidelines were developed in response to the EPA Assistant Administrator for Water's request that conference members relay to him what they need to implement the EPA's watershed protection approach.

The "Watershed Approach" workshop was offered twice—first during Session 5, then repeated during Session 7. The summary below includes ideas from both sessions.

A. Introduction

Traditional land use planning techniques for preserving open space are often not sufficient to ensure full protection of natural resources. For example, one obstacle to long-term protection of water quality is the extension of the watershed over more than one planning jurisdiction. A second obstacle is the prevalent lack of monitoring and enforcement of existing water protection regulations. The EPA's 1990 *National Water Quality Inventory* tells us that in 1988–1990 states monitored only 36 percent of the nation's river miles and 47 percent of its lake acres. For data on the remainder, we must rely on citizen groups.

This reality confirms the premise that despite myriad statutes on the books that mandate water quality protection, the laws still don't protect rivers. People do.

A watershed approach shifts the frame of reference from manmade boundaries (states, towns, neighborhoods, and school districts) to watersheds that follow natural boundaries. With this shift in focus, the community in which we live becomes defined as part of the natural world we share in common with others. This new perspective brings with it both strengths and challenges.

B. Definitions

1. **Watershed.** A watershed is a geographic area in which water, sediments, and dissolved materials drain into a common outlet—a point on a larger stream, a lake, an underlying aquifer, an estuary, or an ocean (U.S. EPA, *The Watershed Protection Approach: An Overview).*

2. **Watershed protection approach.** The watershed protection approach is built on three main principles. First, the target watersheds should be those where pollution poses the greatest risk to human health, ecological resources, desirable uses of the water, or a combination of these. Second, all parties with a stake in the specific local situation should participate in the analysis of problems and creation of solutions. Third, the actions undertaken should draw on the full range of methods and tools available, integrating them into a coordinated, multi-organizational attack on the problems (U.S. EPA, *The Watershed Protection Approach: An Overview).*

C. Strengths of the watershed approach

The watershed approach provides the basis for:

- proactive programs that target sources of pollution concerns before they become problems
- consensus-building among watershed constituents
- cooperative relationships
- potential natural resource districts
- cost-sharing between communities
- holistic approach to land-use issues

D. Challenges of the watershed approach

The watershed approach involves the following challenges:

- potential for overextension of limited resources
- whole watershed may be too big for people to develop a sense of "ownership"
- watershed process is slow, needs time to develop
- technical challenges associated with monitoring a more complex system
- watershed usually does not coincide with political boundaries
- difficulties in coordinating multiple agencies that may have different agendas and charges
- potential problems in transporting volunteers to ends of large watershed

E. Suggested guidelines for U.S. EPA

The following are the combined ideas of over 150 participants at the two sessions of the "Watershed Approach" workshop.

We propose that U.S. EPA consider the following guidelines when implementing the watershed protection approach:

- Build partnerships with those in positions to influence and make decisions. These partnerships should include, but not be limited to, citizen leaders, private businessmen and women, city and county engineers, planning professionals, developers, political leaders, and regulatory agency officials.
- Provide seed money for professional leadership and technical support to community groups.
- Implement citizen-up consensus-building efforts with local, county, regional, state, and national groups.

- Include a public education aspect in the watershed protection approach as a basis for ownership by all constituents.
- Recognize the role and contribution of each stakeholder (constituent groups).
- Provide financial and technical support to decision makers to develop a cohesive watershed management plan.

We urge everyone reading this paper to consider how your organization, agency, or business can build cohesiveness into the watershed approach. An effective program must be based on the willingness of the parts to participate for the good of the whole.

References

U.S. EPA. 1991. *The Watershed Approach: An Overview.* EPA 503/9-92-002. Office of Wetlands, Oceans, and Watersheds, 4503F, 401 M St., SW, Washington, DC 20460.

U.S. EPA. 1992. *National Water Quality Inventory: 1990 Report to Congress.* EPA 503/9-92-006. Office of Wetlands, Oceans, and Watersheds, 4503F, 401 M St., SW, Washington, DC 20460.

Data Analysis for the Technically Impaired

Moderator: **Ginny Barnes,** Audubon Naturalist Society
Presenters: **Joyce Lathrop,** University of Maryland; **Jonathan Pearson,*** Maryland Save Our Streams

Ginny Barnes
Audubon Naturalist Society

Workshop Summary

The discussion portion of this workshop was experimental in format and designed to be very participatory. We chose to focus on biological monitoring because it presented more complex data for interpretation.

The workshop began with Joyce Lathrop's presentation. Then, using an actual watershed as an example, we gave participants raw data as well as graphs. Some of the graphs were deliberately inadequate or even misleading, in order to test the participants, stimulate their thinking, and show them that they might not be so technically impaired as they believed. After presenting the data and graphs, Jonathan Pearson posed a series of prepared questions, shooting them at audience members in the style of a game show host.

The workshop stressed the following points:

1. Know what you want to achieve by collecting the data.
2. Remember that you are creating a picture of a watershed.
   - Choose metrics (measurements) that relate to your goal.
   - The more metrics you choose, the clearer your picture of the watershed.
3. Know the difference between data analysis and data interpretation.
   - Analysis = the use of descriptive and interpretive statistics to put raw data into an understandable form.
   - Interpretation = what the data mean.
4. Make sure your graphs are meaningful and meet your needs. How you interpret depends on how you analyze.
5. Avoid "data abuse" hazards.
   - Don't try to make your data say something they can't.
   - Don't oversimplify.

*no paper submitted

Joyce Lathrop
University of Maryland

Principles of Data Analysis

Data analysis and interpretation concepts can be applied to any type of monitoring data from terrestrial, aquatic, or marine systems. Examples provided are from freshwater systems, especially streams.

When volunteers return from the field, they bring back raw data or samples. Samples that are brought back (e.g., water samples or jars of benthic macroinvertebrates, commonly referred to as "bugs" even though most are not true bugs) are used to generate raw data. The goal of data analysis is to put this raw data into a form that can be more easily understood and interpreted. Thus, a picture of the water body in the context of the surrounding landscape can be created. Data analysis includes both inferential and descriptive statistics. Inferential statistics examines relationships among variables (e.g., dissolved oxygen and temperature; invertebrate community structure and function attributes, also called metrics). Descriptive statistics is used to create graphic displays that make the data easier to comprehend and, therefore, make interpretation easier. Data interpretation puts analyzed data together to determine what the data mean.

The types of analyses that may be done with a data set depend on the type of data available. For example, if one wants to compare dissolved oxygen levels with temperature, both must be measured at the same time. Likewise, if quantitative analyses are to be done on macroinvertebrate data, such as determining population densities, the samples must have been collected by a quantitative method (e.g., multiplate or Surber sampler). Therefore, data analysis goals should be set before samples are even collected

Three main types of analysis may be done on data: spatial comparisons, comparisons between or among variables, and temporal comparisons. Spatial analyses compare one site to another (e.g., upstream and downstream or ecoregional reference condition). Comparisons can be made between chemical, physical, and biological variables (e.g., habitat and taxa richness, a measurement of the variety of "bugs" present). Temporal analyses examine data that have been collected over some period of time (e.g., over the course of a day or diurnally, weekly, semiweekly, monthly, seasonally, or yearly). Care must be taken when manipulating time frames for data. Data collected every week for a period of years could be used to tell something about weekly, monthly, seasonal, or yearly trends; data collected only once a year can only tell something about year-to-year trends.

Good quality data are essential to proper analysis and

correct interpretation. Thus, it is essential that quality assurance/quality control (QA/QC) protocols be written and followed. Other workshops discussed QA/QC and it will not be discussed here. The level of detail available for analysis and interpretation depend on the level of detail of the data collected. This is especially true of "bug" data. Some macroinvertebrate assemblage attributes (metrics) are relevant only when organisms have been identified to family, genus, or species levels. For example, the percent EPT (percent of Ephemeroptera [mayflies], Plecoptera [stoneflies], and Trichoptera [caddisflies] in the sample) and the EPT taxa richness (number of kinds of mayflies, stoneflies, and caddisflies) are not relevant if these insects have been identified only to order. Percent EPT and EPT richness are relevant and important when these insects have been identified to family, genus or species. Again, decisions need to be made regarding the type of data analysis desired before sampling begins. Streamside identification methods usually rely on order (or higher taxon) level identifications, although some true flies (diptera) and a few other groups are identified to family. Preserved samples can be identified to any level desired.

Only variables that are relevant should be analyzed. For chemical and physical (habitat, flow, temperature, etc.) variables and streamside data collected on macroinvertebrate assemblages, decisions as to which to measure must be made before sampling. For macroinvertebrate sampling, some decisions can be made after the sample is collected, provided that the organisms are preserved and identified in a laboratory. In any case, irrelevant variables and comparisons should be avoided. For example, in Maryland Save Our Stream's benthic macroinvertebrate collection each volunteer is instructed to pick organisms grid by grid until 100 are collected. It may take one to several grids before 100 organisms are obtained and once a grid is started all the organisms are removed from it, so values usually range from 100 to 150. While very low values (less than 60) can tell us that a stream is in dire need of help (assuming the volunteers have put forth great effort to follow proper procedure), generally the number of "bugs" in a sample is less meaningful.

Measuring a larger number of meaningful variables increases the clarity of the resulting picture of the watershed. Again, it is important to know what analyses you will want to do before you begin sampling. obviously, you can't add on variables that weren't originally collected. Preserved benthos samples allow a large number of different metrics to be analyzed, and decisions about which metrics to use can be made later. It is even possible to determine which are the most relevant metrics after a preliminary analysis of your data. Structural attributes are based on the types of organisms (taxa) found and include EPT richness, taxa richness (total number of different kinds), percent dominant taxon, and biotic indices, among others. Functional attributes are based on how the organisms obtain food and include scraper-to-filterer ratios. EPA's *Rapid Bioassessment Protocols* describe several possible metrics. Volunteer groups should check with their state agencies for the ones being used by their state.

Care should be taken when graphing the variables. Avoid overcrowding the graph. It's better to have several good graphs than one confusing one. Some variables lend themselves to using a single graph. For example, taxa richness, EPT taxa richness and non-EPT taxa richness could easily be shown on the same graph. Variables with very different ranges are best shown on separate graphs. If you really want to put them on the same graph, then both a Y and a Y2 axis are used for showing scales and labeling. For example, habitat data that ranges from 0 to 166 and biological score that ranges from 9 to 42 can be shown on a graph together if a Y and Y2 axis are used and labeled with the two different scales. Bar graphs work well when data are compared between sites (spatial) and for year-to-year changes (temporal). Line graphs work well for displaying data collected at short intervals (temporal) and for comparing variables with other variables (e.g., DO and temperature). Pie charts are acceptable for comparing percentages (e.g., percentage of sites in unimpaired, moderately impaired, and severely impaired categories), but are otherwise not very useful.

In making interpretations, volunteers should recognize what their data can and cannot tell them. Remember that the more detail you have in your data, the more discriminatory power you have. All data should be compared to a standard or reference. Chemical data are compared to an established standard. Consult your state or EPA for these standards. Biological data should be analyzed and interpreted in relation to some established reference. Ideally, data should be compared to a reference condition developed from many years of data collected from several reference sites. Data can also be compared to a single reference site. In either case the reference sites chosen are the least-affected comparable (e.g., third order stream to third order stream) water bodies in either the same ecoregion or the same area. Upstream/downstream comparisons can also be made. These are less desirable in many cases (depending on your data objectives) since the upstream site may also be impaired.

Interpretation also involves trying to determine whether some human activity has affected the water body. Sources of variation from an accepted value (reference or standard) include (1) error in measurement or collection, (2) natural variation (e.g., different season, weather conditions) between sites or sampling times, and (3) human impact. The first two should be ruled out before any definitive statement about human impact is made. QA/AC protocols reduce the first; information about weather and other natural variables can help eliminate the second.

An Interdisciplinary Approach to Monitoring

Moderator: **Meg Kerr,** University of Rhode Island Coastal Resources Center
Presenters: **Bill Stapp,** GREEN; **Robert Williams,** Illinois Rivers Project; **Lisa Bryce-Lewis,** NW Watershed Alliance

Dr. William B. Stapp
Global Rivers Environmental Education Network (GREEN)

Project GREEN: An Interdisciplinary, International Student Network

One challenge for educators entails more effectively conveying fundamental science and environmental information. While it may be difficult to get excited about the periodic table, people are intrinsically captivated by the world around them. Environmental education—giving shape and meaning to the principles of the natural and social sciences through the tangible and the visible—has proven to be an effective tool for engaging people's interest. Many environmental educators see education heading in a direction that includes the weakening of subject barriers, making education more relevant, focusing on creativity and curiosity, linking local and international issues, meeting the learning needs of all children, and creating partnerships between schools and the scientific, business, and neighborhood communities.

GREEN—A brief history

1. The Huron River Project

The seeds for GREEN (Global Rivers Environmental Education Network) were planted in 1984 when University of Michigan faculty and students developed an interactive water monitoring project with teachers and students from high schools located in the Huron River watershed in southeast Michigan. Huron High School was an ideal site for implementing a pilot water quality monitoring program because it lies near Gallup Park on the Huron River, and because students windsurfed at Gallup Park and jumped from its bridges. There had been reports of windsurfers getting ear infections and diarrhea; at least one individual reported getting hepatitis A. All of these illnesses could be linked to the water quality at Gallup Park.

Huron High School science classes learned how to safely and accurately run nine water quality tests that constitute the National Sanitation Foundation's Water Quality Index. These nine tests are dissolved oxygen, fecal coliform, pH, biochemical oxygen demand, temperature, nitrates, total phosphates, turbidity, and total solids.

Of these tests, fecal coliform was the most revealing in regard to public health concerns of students. Through the water quality monitoring program, students measured levels of 1,500-4,500 fecal coliform colonies/100 ml of water—many times higher than acceptable levels for total body contact.

Students discovered that storm sewers upriver from Gallup Park were implicated as the primary source of fecal coliform bacteria. In response to this situation, students began to compose letters of concern to the newspaper, the city council, the County Health Department, and the Ann Arbor Parks and Recreation Department. The result of student efforts, citizen response, and a School of Public Health study was the erection of a sign at Gallup Park warning the public not to windsurf after rains.

During 1985 and 1986, the project grew to include several other schools along the Huron River. The experiences and insights gained on the Huron River set the stage for work along the Rouge River.

2. The Rouge River Project

To those who lived near the Rouge, it was a river of abandoned automobiles, discarded shopping carts, eroded banks, mammoth log jams, raw sewage, and toxic sediments. The urgency of these problems, and the need to educate young people and communities about them, provided compelling reasons to apply the Huron River Program to the Rouge.

The goals for the Rouge Project included:

- linking diverse schools and communities—rural, suburban, and urban—through the common thread of the Rouge River
- providing a watershed focus and watershed-wide monitoring
- developing an informed citizenry
- increasing student problem-solving skills
- providing an interdisciplinary focus (social, political, economic, and ecological)
- promoting student empowerment and action-taking

The scope and sequence of activities were designed with the project goals in mind and revolved around two key content areas—water quality monitoring and computer networking.

3. An international network

The Huron River and Rouge River projects led to the development of an international network involving thousands of students from multiple watersheds. Students, teachers, community leaders, government officials, and university resource people are brought together by the linking of water systems and schools using computers and face-to-face workshops. Through the program, students learn about the local history, land usage, and water quality of their watersheds in a hands-on project. With the help of an interactive computer

conference, students share data, concerns, strategies, and courses of action as they strive to improve the rivers that they research.

Characteristically, at the end of each project, students from all parts of the watershed meet at an annual Student Congress where they discuss the results of their monitoring activities, assess the state of the watershed, participate in workshops on various action-taking skills, and, finally, come up with concrete plans of action to improve the quality of the local river.

Involvement in GREEN gives students the opportunity to learn about the common dimensions and shared concerns of local water uses and to communicate with each other in addressing their local issues. Projects take on an interdisciplinary approach as history, social studies, humanities, and geography are incorporated to enrich students' understanding of river issues.

During the last four years a variety of new elements have been added to the watershed monitoring programs, including heavy metals testing, cross-cultural links with sister watersheds elsewhere in the world, social studies simulation games, and groundtruthing. GREEN has recently worked with the Aspen Global Change Institute's Ground Truth Studies Project Curriculum and NASA in developing a teacher handbook for Ground Truth Studies which includes classroom use of innovative environmental monitoring techniques (i.e., the use of LandSat satellite images) in monitoring water quality and assessing environmental change (Aspen Global Change Institute, 1994).

Key issues

Our experience with GREEN watershed monitoring programs, and feedback from teachers and program coordinators, have led to the identification of the following key issues which need to be addressed to improve the overall quality of programs that involve school-based environmental monitoring:

- Collaborative teaching in the social studies and the sciences remains problematic even though there are many teachers in both disciplines with good intentions in this direction.
- Teachers have difficulty integrating experientially-oriented educational programs into their regular school curriculum.
- Teachers' lack of confidence and familiarity in working on water quality issues can either (a) make the success of GREEN-type programs become dependent upon outside support (e.g., university personnel) or (b) lead to the elimination of unconventional, but important, components of the program (e.g., simulation games, land-use surveys, computer conferencing, and data graphing). Teachers need to be given opportunities to familiarize themselves with these innovative strategies and adapt them to their own classroom practice. Additionally, GREEN needs to tap the innovative teaching strategies many experienced teachers already use and make those available to others.
- Teachers' lack of familiarity with computer telecommunications reduces the potential of computer networking. Strategies need to be developed to help teachers take full advantage of telecommunications networks.
- Lack of teacher input in program development weakens the program. Experienced teachers (master teachers) need to play a bigger role in designing, evaluating, and disseminating the program.
- Not following a set curriculum brings many unknowns to the classroom. For instance, many teachers have difficulty identifying and utilizing the key players and information resources in their watershed. There is a need to help teachers cope with the uncertainties and unknowns of this type of educational program.

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Dr. Robert Williams

Rivers Curriculum Project, Southern Illinois University

The Rivers Curriculum Project

The Illinois Rivers Project began in February 1990 as a pilot program involving eight high schools along the Mississippi and lower Illinois Rivers. With scientific literacy as the ultimate goal of the Project, students from each of the participating schools collect and analyze water samples from

various test sites along both rivers. The study of the rivers was extended to include historical, social, and/or economic implications of the state of the rivers, thus involving students from classes across the curricular areas of science, social studies, and English. SOILED NET, a telecommunication network linking all of the participating schools with each other and the Project headquarters, provides a technological framework for many of the Project's activities.

The Rivers Project Network has grown to include over 300 schools in an eight-state region. Funding has come from a variety of sources: Illinois State Board of Education Scientific Literacy program, U.S. Fish and Wildlife Service, Illinois Board of Higher Education, Dwight D. Eisenhower Title II Program, National Science Foundation, and Illinois Bell. The Illinois Department of Energy and Natural Resources and Illinois Bell have both provided funding for the production of the Project's student-authored publication, *Meanderings.*

Meanderings, an annual compilation of students' writings, provides the opportunity for students to have their work published. From their study of the river and their surrounding communities, scientific and otherwise, students produce reports, articles, essays, and creative writings. To date, 14 editions of *Meanderings* have been published. Students are also invited to submit articles for publication in the Project newsletter, *The River Watchers' Log.*

The Project held its Fourth Annual Illinois Rivers Project Student Congress in March. Students from high schools in Illinois, Missouri, Iowa, and Indiana gathered in Peoria to share with each other the ideas and experiences gained as a result of their participation in the Project. Topics ranged from the scientific (water quality data) to the historic (slide presentations of local history) to the creative (original music and puppet shows). Response to the Congress was enthusiastic; plans are already in progress for next year's event.

Two major projects continue to develop. First, a National Science Foundation grant has allowed the Project to develop a formal "Rivers Curriculum" in the areas of chemistry, biology, earth science, geography, and language arts that will be applicable to any river in the world. A group of teacher/writers and content specialists gathered in August, 1991, to draft the curriculum. The Project sponsored a Rivers Curriculum Training Session in August of 1992 for 99 interested teachers and in 1993 for 195 teachers from across the country.

Second, a cooperative effort has been undertaken with the Illinois Natural History Survey and the University of Illinois' Water Resources Center to help monitor the zebra mussel as it enters the Midwest. Each school received two monitoring devices through a grant from the Illinois-Indiana Sea Grant Program. Participating schools will continue to monitor the water quality in their respective areas. The data collected will be transmitted to the Environmental Management Technical Center (a division of the U.S. Fish and Wildlife Service) in Onalaska, Wisconsin, and will be used by the IEPA.

For further information contact Dr. Robert Williams, Project Director, or Cindy Bidlack, Project Coordinator, Southern Illinois University, Box 2222, Edwardsville, IL 62026. Phone: 618-692-3788; FAX: 618-692-3359; INTERNET: rivers@eville.uiuc.fred.org

Lisa Bryce Lewis

NW Watershed Education Alliance

Some Practical Tips for School-Based Monitoring Programs

In setting the stage, Dr. Bill Stapp has discussed why an interdisciplinary approach is important. Bill has provided a historical context for school-based monitoring programs by discussing the evolution of the Global Rivers Environmental Education Network (GREEN), and has talked about the current status of monitoring with schools.

My remarks are designed to build on this foundation by discussing practical aspects of interdisciplinary school-based monitoring, and to provide some guidance to groups interested in working with schools on how to design programs that will work in a school setting.

1. Community support

It is very important to work toward making a school-based monitoring program self-sustaining, so that it won't die if a key teacher leaves. One way to do this is to build a network, or circle, of local support for sustaining the program. Working with GREEN, we have developed a flow of partnerships from the national to regional levels designed to help open doors at the local watershed level for multiple partnerships over the long term (see Figure 1). Building long-lasting relationships at the local level is at the heart of sustainability. It takes time and persistence as the program and its partners learn and evolve together. For example, the City of Olympia has made the local watershed education program (Budd/Deschutes Project Green) a line item in its annual budget. Similarly, a school district is incorporating the GREEN model into their entire middle school curriculum, across disciplines. by partnering, schools and community players share the successes and move innovative educational approaches from the "fringe" to the "core," embedded within the system.

2. Advisory board

Form an advisory board that contains wide community representation. Include people who are involved in decision making; people who have a buy-in to the program and can help sell the idea to their peers.

3. Watershed coordinator

A coordinator who serves as a link between the school system and the community is critical to success— "People work with people." The coordinator serves as a liaison, keeping communication going and leveraging support for the monitoring program. The coordinator should be someone who knows

both the school system *and* the community structures, and who (preferably) is locally based.

4. "What is in it for them"

Whether you are discussing your project with people from school administrative systems or businesses, agencies, local jurisdictions, or volunteers, you need to spell out *what is in it for them*. What will they gain by being involved in your collaborative effort? School districts have systemic plans, with goals and objectives. How will working with you on monitoring and community projects help them meet their goals? Be explicit.

5. Assessment

In assessing the success of your program, think about what outcomes each player is seeking. Evaluate your results based on the goals identified by those involved. Be sure that the objectives considered are relevant to all the players—i.e., business partners, local jurisdictions, state and federal agency partners, students, teachers, and, ultimately, the environment. Don't forget that last "player"; you want and need to have environmental improvements as well.

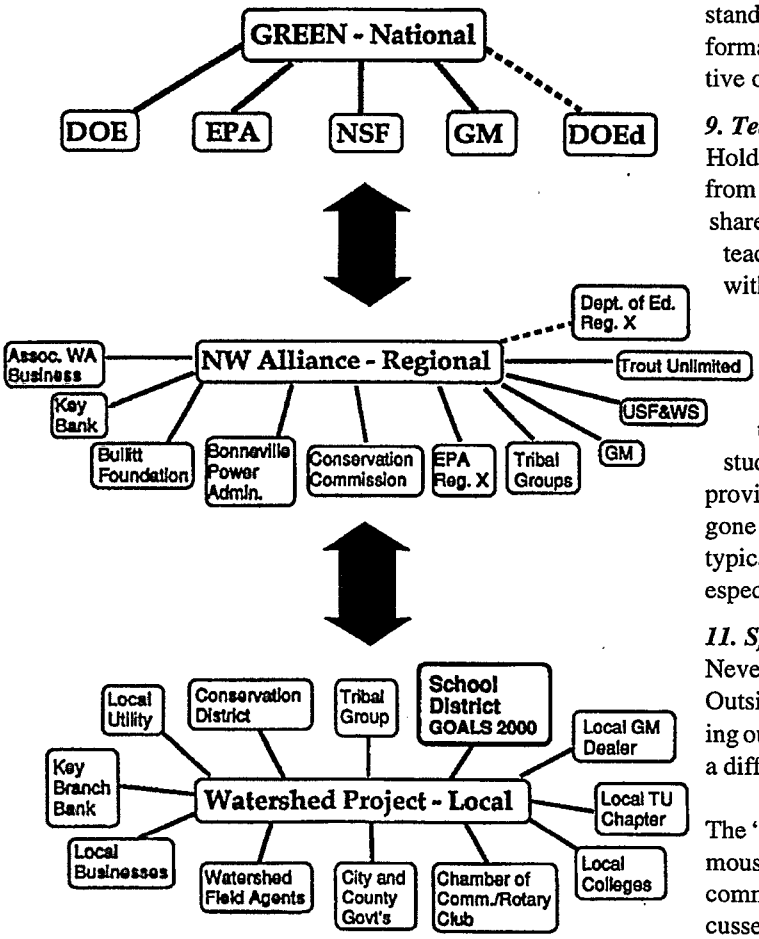

Figure 1. "Wheel of partners."

6. Be incremental

Involve just a segment of teachers at first, then more—for example, start with just elementary teachers, or just secondary; or with teachers from just one school per district. We recommend starting with self-selected teachers first; they can be catalysts for greater school and district participation—the enthusiasm is contagious.

7. Student Congress

A yearly Student Congress brings community and schools together, with students as leaders. Students have an opportunity to share with one another and with the community what they have discovered (data, interviews, etc.); their ideas for taking action based on their information; and, perhaps, the results of their community action.

8. Teacher training/Community training

An annual teacher training institute provides a forum for connecting teachers to the community. By involving community members (local governments, civic organizations, businesses) in the institute, teachers can learn of upcoming community projects that could use student help (e.g., a stream rehabilitation project), and teachers can increase their understanding of local issues and perspectives on the issues. Panel formats work well for these objectives, followed by interactive opportunities.

9. Teacher meetings

Hold regular meetings during the school year of teachers from throughout the watershed (i.e., interdistrict) to learn and share with each other, and to plan. This provides support to teachers (many of whom are otherwise out on their own with their innovative teaching) and increases participants' sense of watershed identity.

10. Money for buses and substitutes

One of the biggest obstacles in a school-based monitoring program is transportation—simply getting the students out to the field. You also need to think about providing substitutes for secondary teachers who must be gone more than one period of the day for field work. Funders typically like to fund such discrete parts of a program, especially when their money helps get kids to the river.

11. Special Education involvement

Never underestimate what "challenged" students can do. Outside of the traditional classroom, these students are finding out they can contribute to the community and really make a difference.

The "why" of interdisciplinary monitoring is really synonymous in my mind with community-based learning. When community and schools work together, the elements discussed are worth considering as steps you can take to build strong interdisciplinary, locally beneficial monitoring and service programs.

Building Partnerships with Federal Government Agencies

Moderator: **Jerry Schoen,** Massachusetts Water Watch Partnership
Presenters: **Don Duff,** USDA Forest Service National Partnership Coordinator; **Susan Harris,** National Park Service River and Trail Conservation Assistance Program; **Alice Mayio,** U.S. EPA; **Tom Muir,*** U.S. Geological Survey Citizen Monitoring Liaison; **Dave Nolte,** Bureau of Land Management's Bring Back the Natives Program Coordinator

Jerry Schoen
Massachusetts Water Watch Partnership

Introductory Remarks

Federal environmental agencies can be broken down into several categories:

I. Land management agencies

A. Forest Service

The FS of the USDA manages land and water resources on some 156 national forests and grasslands across the country. It is responsible for providing clean water and habitat for fish and wildlife resources, which happen to include about 50 percent of all the trout and salmon resources in the U.S. It also manages lands for other multiple uses, such as timber production, livestock grazing, mineral, and oil and gas development.

The Forest Service is divided into 9 regions around the country, each of which contains 10 or more forest or grassland units. Each forest unit may have several districts. Management and monitoring decisions are made at each of these levels.

B. Bureau of Land Management

The BLM of the U.S. Department of the Interior (USDI) manages some 272 million acres of public land (about 48 percent of all federal lands), mostly in the Western U.S. These lands include approximately 155,000 miles of streams and rivers and 4.1 million surface acres of ponds, lakes, and reservoirs. Like the Forest Service, BLM manages for multiple uses such as fish and wildlife, timber, grazing, etc.

BLM is organized in a regionalized structure by geographic location of public lands managed at a state office level. Under each state office are BLM Districts, which also include one or more Resource Areas. For example, Oregon has 11 Districts. One of these, the Prineville District, has two Resource Areas: Central Oregon and Deschutes. In order to accommodate ecosystem management, the BLM is currently reorganizing, with some districts probably to be combined into "provinces." These changes will take place over the next year.

In attempting to balance multiple uses, both FS and BLM tend to focus on water quality impacts of sedimentation, streambank erosion and other fish habitat alteration, temperature, dissolved oxygen levels, pH and toxicity problems associated with mine effluent, and other traditional point and nonpoint problems. Biological monitoring, both benthic invertebrate monitoring and fish sampling, is becoming an increasingly important assessment and management tool for these agencies.

II. Land conservation and service-related agencies

A. National Park Service

The National Park Service is charged with conserving "the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Two branches of NPS are of particular interest to volunteer monitors. The most well known of these is the National Park system, which manages Parks, Monuments, Seashores, and Recreation areas across the nation. Public involvement with these units is usually limited to often perfunctory hearings within abutting towns and counties.

Today we're going to feature a different aspect of the NPS—the Rivers, Trails and Conservation Assistance program. This program advocates and assists community-based conservation to protect rivers, trails, and greenways. In other words, their focus is more on helping citizen groups help the rivers, rather than getting help from citizens to manage the resource themselves.

RTCA staff are found in each of 10 regional offices throughout the country, and at several state-level field offices. Contact with the RTCA program is usually made through the regional and field offices.

B. Soil Conservation Service

The mission of the SCS is to promote conservation of natural resources through technical assistance to farmers, ranchers, and local communities.

The primary organizational unit of SCS is the state. States are organized into state offices, where the planning and engineering staffs and resource specialists work. Several area offices within each state are mostly administrative in function. Field offices (usually one per county) consist of a district conservationist and zero to three staff. In addition, four National Technical Centers provide technical support to the state organizations.

SCS works in very close partnership with Soil and Water Conservation Districts (SWCDs), which are locally elected (volunteer) boards with quasi-government functions. There

*No paper submitted

is generally one SWCD for each field office. SCS is a far-flung organization and most Field Offices have a lot of latitude in decision making.

Historically, SCS was mostly concerned with getting soil and water conservation practices adopted and not with measuring environmental quality or the effectiveness of conservation practices. SCS is now looking to better quantify the water quality effects of conservation practices. SCS has traditionally worked primarily with farmers. They are now also heavily involved in urban stormwater runoff and other nonpoint pollution problems.

III. Regulatory and science-related agencies

A. Environmental Protection Agency

EPA is an independent agency charged by Congress to protect all the nation's land, air, and water systems. It operates under a mandate of national environmental laws such as the Clean Water Act, Safe Drinking Water Act, and similar laws. Its role is basically to implement those laws by developing environmental regulations, ensuring the compliance of government and industry with those regulations, issuing guidelines when regulations don't apply (e.g., voluntary nonpoint pollution management activities), and overseeing state environmental programs.

EPA has a Headquarters Office in Washington, DC, 10 Regional Offices, and a number of laboratories around the country. Its operational style is fairly centralized: generally HQ develops policy, programs, regulations, and guidance, and looks to the regional offices to implement them. It is the regional office staffwho work most closely with state and local agencies and the public. As a whole the EPA is not very educational/outreach-oriented, although that is changing.

B. Fish and Wildlife Service

The FWS of the USDI is the lead federal agency in the conservation of migratory birds, threatened and endangered species, certain mammals, and sport fishes. This includes the management of a system of National Wildlife Refuges and national fish hatcheries, and enforcement of regulations and Acts covering the management and protection of these species. FWS often conducts studies on impacts of human activities on various wildlife species.

C. U.S. Geological Survey

The mission of the USGS is to provide geologic, topographic, and hydrologic information that contributes to the responsible management of the nation's natural resources. To accomplish this mission the USGS conducts and sponsors research in geology, hydrology, mapping, and related sciences.

USGS conducts many water research and water quality monitoring activities, the largest of which is the National Water Quality Assessment (NAWQA) Program. NAWQA is designed to determine the status and trends of the nation's rivers, streams, and groundwater, and to provide a scientific understanding of the natural and human factors affecting the quality of these resources.

Donald A. Duff

National Partnership Coordinator, Forest Service/Trout Unlimited

Forest Service Partnerships

The Forest Service, U.S. Department of Agriculture (USDA) manages land and water resources on some 156 National Forests and Grasslands across the country for the public's use and enjoyment. This covers some 191,000 acres of lands, 128,000 miles of stream, and 2.2 million acres of lakes and reservoirs, as well as 16,500 miles of coastline.

Trout Unlimited partnership

The Forest Service program goal, in working with Trout Unlimited and other conservation groups, is to build volunteer opportunities for citizen angler and interested stream observers, utilizing both educational and technical skills, for the conservation and management of watershed and stream ecosystems on the National Forests. This Forest Service and Trout Unlimited Partnership is a joint cooperative effort of the Forest Service's Rise to the Future Fisheries Program to expand the national emphasis and visibility of aquatic habitat and fisheries resources in National Forests across the nation. The Rise to the Future Fisheries Program meshes with Trout Unlimited's Embrace-A-Stream Program for the protection and management of streams and watershed resources for fisheries and water quality needs. Another important component of the program is the Bring Back the Natives initiative, which emphasizes the on-the-ground conservation, protection, and management of native fishes, especially those that are threatened, endangered, or at risk from threats that could lead to their extinction.

The Forest Service and Trout Unlimited cooperate with the USDI BLM in all these program initiatives to jointly involve volunteers in the process of watershed restoration and protection through a water quality and aquatic resources monitoring program on federal lands that are administered by each agency, many times side by side within a watershed.

Forest Service information needs

The Forest Service has many resource information needs, most of which concern the condition, status, and trend of the natural resources. But information on the interests and concerns of citizens, both those living the local area and those who visit the area, is also needed. Many of the needs involve the gathering and collection or inventory and monitoring of natural resources, especially physical and biological resources of the land and waters, with the wildlife that uses them, so that informed management decisions may be based in part on citizen participation. Volunteer assistance in gathering this information can be used at all levels of management, especially at the Ranger District level.

Volunteer opportunities

Volunteer opportunities for inventory and monitoring of land and water resources, including the physical, chemical, and

biological characteristics, are available on all National Forests. Volunteers may be recruited and trained, or they may ask to be involved by contacting individual National Forests. They can assist forest personnel in the collection of water quality data needs. These citizens' collections, along with routine forest monitoring and research data, help the agency meet the intent of the Clean Water Act, and other national environmental policies for clean air, water, and lands.

Forest Service volunteers are selected without regard to gender, race, religion, or disability. Those under 18 years usually serve as a member of a group and must have written consent of a parent or guardian. The Forest Service will work with organized groups to identify, design, and construct cooperative "partnership" projects that can enhance or recover the natural resources on National Forests. Usually, the group works under a "formalized" agreement or memorandum of understanding, which could be operational at either the local, regional, or national level. For more information on specific volunteer activities in your area, contact your closest National Forest or Ranger District Office.

Susan Harris

National Park Service; Rivers, Trails and Conservation Assistance Program

Rivers, Trails and Conservation Assistance Program

The mission of the Rivers, Trails and Conservation Assistance Program (RTCA) is to advocate and assist community-based conservation action to protect rivers, trails, and greenways. Our program is oriented toward local communities and is based on the principle of partnerships—RTCA can help bring together residents, landowners, private organizations, and government agencies to conserve an area's natural and cultural resources.

Interested nonprofit organizations, local governments, and states can request assistance from RTCA for their particular conservation effort. RTCA helps these groups to identify resources, understand the issues, set goals, and choose among alternatives. The goals and needs of river protection, restoration, and enhancement projects vary according to the specific conditions. However, for many creek, river, or watershed projects, water quality is a critical issue. Increasingly, volunteer water quality monitoring is a valuable and effective component of these projects, both as an important data resource and as an effective way to involve people in river stewardship.

When volunteer water quality monitoring is identified as beneficial to a particular project, as part of the overall project coordination RTCA staff can help link interested volunteers, monitoring expertise, and appropriate agencies. RTCA could also assist a project in attracting financial support and help coordinate effective use of monitoring information by various entities.

If the conservation project involves an adjacent National Park Service unit, you should contact the park unit directly to gain their involvement. In some cases, a National Park site may offer a publicly accessible location to conduct sampling. As the National Park Service's work continues to extend beyond park boundaries, both the Rivers, Trails and Conservation Assistance program and National Park units can become new partners in volunteer water quality monitoring efforts.

For more information on the Rivers, Trails and Conservation Assistance Program nationwide, contact:

National Park Service
Rivers, Trails and Conservation Assistance Program
P. O. Box 37127
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(202) 343-3780

Alice Mayio

U.S. Environmental Protection Agency

EPA's Volunteer Monitoring Program

Thank you for the opportunity to share some thoughts with you today about federal roles in volunteer monitoring. EPA has supported volunteer monitoring for many years, starting with sponsorship of the first national conference for volunteers in Rhode Island in 1988.

Why does EPA care about volunteer monitoring?

First, we recognize the need for educated stewards of the environment—folks who practice pollution prevention and educate others about water quality issues.

Second, it is clear that federal, state, and local water quality managers need the data volunteers can provide. Only a small fraction of the nation's waters—about 20 percent of streams and rivers and less than half our lakes—are monitored every two years by the states. We need more comprehensive monitoring data to help us make better decisions about where to put increasingly scarce funds to work fighting pollution. This is really the driving need behind EPA's support of the volunteer monitoring movement.

There are three major points I would like you to take back with you today about EPA's volunteer monitoring program:

1. Guidance and assistance

First, EPA's role is one of encouraging volunteer monitoring through two main vehicles: guidance/technical assistance and outreach. Technical assistance involves developing technical guidance for volunteers and program sponsors on how to monitor and how to set up programs; we also provide some technical assistance, mostly at the regional level and primarily in quality assurance. Outreach involves spreading the

word about volunteer monitoring by developing tools for information exchange (such as *The Volunteer Monitor* newsletter, brochures, an electronic bulletin board forum for volunteers, and regional and national conferences), and encouraging states to support volunteer programs.

It's important to note that EPA doesn't manage volunteers, give people sampling kits, organize cleanups, or directly fund volunteer programs. The only opportunities actual volunteers have to really "work with EPA" is as advisors and reviewers, helping us develop the guidance, manuals, and outreach tools for the program.

2. EPA's grants process

The second major point I'd like you to take home with you is that, next to issuing volunteer monitoring documents and outreach tools, I believe EPA's greatest contribution to volunteer monitoring is through its grants process.

Under various provisions of the Clean Water Act (CWA), EPA issues grants to the states to help control pollution. These include nonpoint source control grants (Section 319 of the CWA), Clean Lakes water quality assessment grants (Section 314), and National Estuary Program grants (Section 320).

These grants are administered through the 10 EPA regions, which solicit grant proposals from the states and review and approve or disapprove them. Under these CWA sections, EPA gives grant money to the **state water quality agencies,** who in turn may either use the money themselves or pass it through to local and regional governments, nonprofits, academics, and others.

How have these grant programs been used to support volunteer monitoring?

- **Nonpoint source control grants** have been used to set up volunteer programs that monitor the effects of nonpoint source management activities or that identify nonpoint source pollution problems so controls can be implemented.
- **Clean Lakes water quality assessment grants** have been used for years to fund volunteer programs which are many states' primary source of information on lake conditions.
- **National Estuary Program grants** help fund the development of comprehensive management plans in estuaries of national significance; volunteer monitors and other citizen groups are often involved in developing these plans.

In all three cases, highest priority for funding generally goes to projects that generate quality data using accepted techniques and following approved quality assurance protocols. Many of these projects also include public education components.

3. A small program—so far

The third and last point I'd like you to carry away this afternoon is that EPA's volunteer monitoring program is really quite small. At Headquarters in Washington, DC, it consists basically of myself (in the monitoring program), and one person in the coastal program who has some volunteer monitoring responsibilities. There are also staff in the 10 EPA regional offices who include volunteer monitoring in their job descriptions. However, almost all of these regional volunteer monitoring coordinators have a wide range of additional responsibilities and can devote only small amounts of time to volunteer monitoring support. How much time they can devote to volunteer monitoring depends on the management priorities of their regions, and varies a great deal between regions.

I hope that as volunteer monitoring programs continue to flourish and more and more water quality managers at all levels of government come to recognize their value, EPA's support will continue to grow. To help make that happen, I urge you to connect up with the EPA volunteer coordinators in your regions; let them know what your program is doing; invite them and their managers to your meetings, and seek their advice. And if you have any questions about EPA's program, or about our documents, outreach tools, or conferences, don't hesitate to get in touch with me at U. S. EPA, 4503F, 401 M St., SW, Washington, DC 20460.

David A. Nolte

Trout Unlimited/Bring Back the Natives Coordinator

Bring Back the Natives

BLM program goal

To guide the continued management of fish and wildlife resources and their habitats, the Bureau of Land Management (BLM) has initiated a major strategy, *Fish & Wildlife 2000—A Plan for the Future*. This strategy outlines a comprehensive master plan for the effective long-term management of fish, wildlife, and special status plant resources on public lands. It encourages cooperation between the BLM and all groups, public or private.

There are approximately 18 National Strategy Plans associated with *Fish & Wildlife 2000.* These include Bring Back the Natives, Neotropical/Nongame Migratory Bird Conservation Plan, Waterfowl Habitat Management on Public Lands, Riparian-Wetland Initiative for the 1990's, Anadromous Fish Habitat Management, and Special Status Fishes Habitat Management. The BLM is working with Trout Unlimited, the nation's leading coldwater fisheries conservation group, and other conservation groups to involve volunteers in the process of watershed and riverine restoration on public lands.

Information needs

The agency has a variety of information needs related to managing public lands. Essential is the gathering of information related to the status and trends of the resource. Monitor-

ing of watersheds and areas of critical concern, scientific research, compilation of data, and development of information to aid in public participation and management of public lands are all areas where citizens can be involved as volunteers.

Volunteer opportunities

Volunteers are involved with a diversity of opportunities including fish and wildlife, recreation, range management and forestry, energy and minerals, archaeology and history, watersheds, administrative support, public information, wild horses/burros, engineering and surveying, data management, planning and wilderness for group or individual interests. Water-quality-related activities include assisting BLM professionals in soil and water conservation projects, riparian protection, erosion control, stream temperature monitoring, water quality sampling, and habitat surveys, and participation in resource management planning by aiding in the identification of areas of critical concern.

Most BLM volunteers serve part-time during a particular season, weekend, or project. BLM volunteers have the same benefits as federal government employees for compensation for work-related injuries and tort claims protection. Although volunteers contribute their services without pay, they may deduct out-of-pocket expenses on income tax returns within the limits set by tax laws. If a volunteer is a member of an organized group, BLM personnel will work with the group to identify or design a cooperative volunteer "partnership" project that the group can work on together. This is usually formalized by a cooperative agreement or memorandum of understanding and may occur at the local, state, or national level.

Bring Back the Natives

Bring Back the Natives is funded by the National Fish and Wildlife Foundation, Washington, DC. This key national fishery program is the first national campaign combining two major federal agencies, the USDA-Forest Service and USDI-Bureau of Land Management, with partnerships including state agencies, local organizations, private businesses, citizens and landowners, and Trout Unlimited. This program seeks to restore the health of entire riverine systems and their native species through a cooperative effort that stresses improved watershed and ecosystem management. Currently 28 projects are being funded through this program nationally.

Successful implementation of the Bring Back the Natives program will substantially benefit watersheds, water quality, and endemic fishes. Local communities, including private business, landowners, and citizens, are encouraged to seek partnerships with the Bureau of Land Management and/or USDA Forest Service for watershed-level projects that meet Bring Back the Natives program criteria. The BLM needs to expand its habitat enhancement and educational opportunities and work with a multitude of partners to accomplish management objectives and goals of fishery strategies such as Bring Back the Natives offers.

Bring Back the Natives is now serving as a model for other agencies. For example, through Fisheries Across America, the U.S. Fish and Wildlife Service is replicating the model of Bring Back the Natives. These types of programs will serve as catalysts for change and involvement of all citizens concerned about the future quality of our watersheds, our water, and our planet's life.

Regional Breakout Discussion Session

On the morning of April 12 (the second day of the conference), participants broke into small discussion groups according to which of EPA's nine geographical regions they represented. The breakout groups were charged with these three tasks:

1. **Develop a vision** for the future of volunteer monitoring.
2. **Identify obstacles** to the use of volunteer-collected monitoring data.
3. **Recommend "next steps"** volunteer monitors should take to improve data use and strengthen volunteer monitoring regionally and nationally.

The results of the brainstorming and discussion in these breakout groups are summarized below.

1. Vision for the future

- Improved communication between data users and data gatherers, as well as among volunteer programs themselves. This better communication enhances data sharing, allows groups to learn from each other's mistakes and successes, increases publicity for volunteers' activities, and strengthens monitoring groups' ability to educate the public and decision makers about water quality issues.
- Strong role for EPA, both regionally and nationally, in enhancing communication; promoting standardization of methods; assisting with training, data management, and quality assurance; publicizing success stories; encouraging state use of volunteer data; and securing funding sources for volunteer programs.
- Recognition by government agencies of the value of volunteer data. Agencies work cooperatively with volunteer monitors and share agency data with volunteers.
- Strong state or regional volunteer monitoring associations.
- A watershed approach to volunteer monitoring.

2. Obstacles to use of volunteer data

- Government resistance to admitting the data's credibility.
- Lack of standardized methods (and consequent inability to compare data over time or between programs).
- Lack of information—particularly from potential data users—concerning needed quality assurance/quality control methods.
- Lack of coordination and leadership from EPA regions.
- Insufficient communication and data sharing, both between government agencies and volunteer programs, and among volunteer programs themselves.

3. Recommendations for "next steps"

Wide-ranging recommendations for future directions and actions spanned the following categories:

a. State and regional coordination

- Form statewide or regionwide volunteer monitoring associations that would incorporate state, local, and federal agencies as well as volunteer monitoring organizations. Associations would address issues such as:
  - building teamwork among programs
  - improving ties between volunteer programs and government
  - exploring standardization of methods
  - sharing information on funding sources
  - producing regional directories, databases, and newsletters
  - sponsoring regular conferences
- Strengthen the role of the regional EPA volunteer monitoring coordinators. This role should include:
  - working to organize regional conferences
  - involving state and federal agencies in supporting volunteer monitoring
  - providing technical support

b. Communication

- Support or develop the following communication tools:
  - newsletters
  - directories
  - conferences
  - published success stories
  - centralized libraries/clearinghouses
  - educational outreach campaigns
  - shared mailing lists
  - regional or statewide databases of volunteer data
  - computer networks, electronic bulletin boards

c. Method standardization and QA/QC

- Develop standard monitoring protocols, reporting procedures, and equipment recommendations for monitoring specific ecosystems.
- Work with data users to specify needed level of data quality for individual projects.
- Develop national, regional, and/or state guidance on quality assurance for volunteers.
- Consider standardized training/certification of volunteers.

d. Watershed approach

- Adopt watershed-level goals and plans and monitor whole watersheds.
- Incorporate many types of water bodies (including groundwater and wetlands) and many types of monitoring (e.g., habitat, fish, plants).
- Integrate all the various monitoring and management activities within the watershed.

e. Diversity (cultural, age, class, racial)

- Increase education on water quality issues to groups currently outside the volunteer monitoring "circle."
- Use school-based monitoring programs to reach inner-city children and communities.
- Develop community-based partnerships.
- Actively share monitoring programs' findings with affected communities.
- Use watersheds as a way to link communities.
- Commit to diversity in organizational structure, literature, and events.

Writing Wall Responses

The conference featured a "Writing Wall" that gave participants a chance to vote on the following eight questions. The questions and suggested answers were displayed on large posters along one wall. Participants were allowed to choose only one answer for each question. Space was also provided for writing in comments, and in some cases "write-in" responses received a substantial number of votes. In fact, for question 7, a write-in response won out over all the "officially" provided answers.

1. What is the biggest obstacle to the use of your volunteer data by government?

	(# of votes)
No staff to interpret/manage volunteer data	38
Skepticism about data quality	32
Lack of awareness of volunteer data	10
Mistrust of motives of volunteer programs	6
Data not provided in proper format	2
Data doesn't match government needs	2

2. How has your program's data been used the most?

To educate the public	44
To screen for problems	19
To educate decision makers	13
To bring about local action	11
To bring about legislative change	2

3. What is most needed to help build credibility of volunteer data?

More involvement of potential data users	35
Quality assurance protocols	21
Increased awareness of use of volunteer data	17
Better volunteer training	7
More involvement of water quality professionals	5
Standardized methods	5

4. What are the major roadblocks to the growth of your program?

	32
Insufficient funding	15
Lack of time (write-in)	12
Lack of committed volunteers	10
Lack of scientific/technical help	9
Data not used	
Lack of regional/local volunteer monitoring networks	7

5. What type of technical assistance does your program need most?

Data analysis/presentation	16
Training	14
Data management	13
Laboratory support	12
Regionally standardized methods	10
Monitoring method manuals	8

6. What is the best way to avoid volunteer burnout?

Ensure data are used	27
Skill-building/growth opportunities	19
Realistic program goals	15
Feedback from program coordinator	10
Action (write-in)	10
Opportunities for social interaction	2
Realistic job description	1

7. In what areas should EPA increase its support of volunteer monitoring?

Money (write-in)	26
National/regional conferences	19
Technical assistance	15
Methods manuals	10
Volunteer Monitor newsletter	5
Electronic bulletin board	5

8. What topics would you like to see emphasized at the next national conference?

Watershed management techniques	37
Data interpretation	15
Training in monitoring techniques	15
Data sharing and networking	11
Monitoring other ecosystems (e.g., air, groundwater)	9
Enforcement (write-in)	8
Diversity (write-in)	5
Data management	2

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