Promoting Watershed Stewardship

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Proceedings Editor: Eleanor Ely
Associate Editors: Abby Markowitz, Richard Ely, Margaret Nugent
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OPENING PLENARY SESSION

Gaylord Nelson
Founder of Earth Day, Counselor of The Wilderness Society The Wilderness Society, 900 Seventeenth Street, NW, Washington, DC 20006-2596, 202/833-2300

Environment; Population; Sustainable Development
Where Do We Go from Here?

The history of man has been influenced by many revolutions, but none more important than the Agricultural Revolution followed by the Industrial Revolution. We are now at the threshold of a third great revolution, the transition to a sustainable society . . . . which can be described as "one that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Forging and maintaining a sustainable society is THE challenge for this and all generations to come. At this point in history, no nation has managed, either by design or accident, to evolve into a sustainable society. We are all pursuing a self-destructive course of fueling our economies by consuming our capital; that is to say, by degrading and depleting our resource base; and counting it on the income side of the ledger. That, obviously, is not a sustainable situation over the long term.

The bottom-line question is obvious and critical: Can we as a nation evolve into a sustainable society during the next four or five decades? That is to say, a sustainable society which we would view with approval. The answer is yes; if we have strong political leadership and the support of a society imbued with a guiding environmental ethic. The evolution of such an ethic within our culture is happening now at an accelerating pace.

Increasingly, we have come to understand that the wealth of the nation is its air, water, soil, forests, minerals, rivers, lakes, oceans, scenic beauty, wildlife habitats, and biodiversity. Take away this resource base and all that is left is a wasteland.

The Worldwatch Institute states the same case in another way:

Three biological systems; croplands, forests, and grasslands; support the world economy. Except for fossil fuels and minerals, they supply all the raw materials for industry; except for seafood, they provide all our food.

In short, that's all there is. That's the whole economy. That's where all the economic activity and all the jobs come from. These biological systems contain the sustaining wealth of the world. All around the planet these systems are under varying degrees of stress and degradation in almost all places, including the United States. As we continue to degrade them, we are consuming our capital. And, in the process, we erode living standards and compromise the quality of our habitat. It is a dangerous and slippery slope.

One of the major political obstacles to environmental progress is the widely held and mistaken belief that protecting the environment threatens jobs. That's why we so frequently hear political and business leaders, economists, and others who should know better vacuously asserting they "are for the environment if it doesn't cost jobs." That has been a favorite clich among politicians and leaders of both political parties. It discloses a failure to understand the fundamental connection between the environment and the

economy. If we are going to manage our economy intelligently, it must be understood that jobs are inextricably tied to the environment and totally dependent upon it.

I have a friend whose guiding theology for all political matters is the editorial page of the Wall Street Journal. He could never quite understand that there is a direct and beneficial connection between a healthy environment and a prosperous economy until I described the connection in the jargon of his business world. I said to him, "Look at it this way and the connection becomes obvious. The economy is a wholly owned subsidiary of the environment. All economic activity is dependent upon that environment with its underlying resource base. When the environment is finally forced to file under Chapter 11 because its resource base has been polluted, degraded, dissipated, irretrievably compromised, then the economy goes down into bankruptcy with it because the economy is just a subset within the ecological system."

Professor Donella Meadows states the case in another way:

Some day the media will learn that the environment is not an intermittent news story, not a special interest, not a win-lose sports event, not a luxury, not a fad, not a movement, not discredited, not faltering, and not something to pay token attention to one day a year. It is a beat far more important than Wall Street or Washington. Its laws are stronger than Newt's, its moves are more important than the Federal Reserve's, its impact overwhelms that of the stock market or the next election.

The environment is not one player on the field; it is the field. It holds up, or fails to hold up, the whole economy and all of life, whether the spotlight is on it or not.

In a dramatic and sobering joint statement (1992), the United States National Academy of Sciences and the Royal Society of London, two of the world's leading scientific bodies, addressed the state of the planet in the following words:

If current predictions of population growth prove accurate and patterns of human activity on the planet remain unchanged, science and technology may not be able to prevent either irreversible degradation of the environment or continued poverty for much of the world. . . .

The future of our planet is in the balance. Sustainable development can be achieved, but only if irreversible degradation of the environment can be halted in time. The next 30 years may be crucial.

Is there any other single issue even a fraction as important as this? Yet, the leaders of both political parties will go through this campaign in silence about sustainability and the disastrous consequences of continued exponential population growth.

If our political system is unable to engage in an honest, forthright discussion of the major challenge of our time, is it any wonder there is widespread disillusionment with the system? The public can distinguish between real substance and inconsequential political

puffery. Yes, forging a sustainable society will involve all kinds of controversy. Achieving that goal will require that we move vigorously to stabilize our population. That of necessity requires that we address the immigration rate and the fertility rate, and that we significantly reduce both.

When experts are asked to list the most critical environmental problems, they are practically unanimous in ranking at the top of the list the calamitous consequences of continued exponential population growth.

For the United States, the U.S. Census Bureau population projections for mid-next century range from about 400 million to 522 million. To be on the safe side, it would be wise to use the Census Bureau's high projection. Indeed, in the 55 years between 1940 and 1995, U.S. population doubled and is likely to double again by mid-next century. Grappling with these numbers and understanding what they mean requires that we try to think of the human situation measured in terms of millions and billions; a challenge that boggles the mind.

Proponents of the cornucopian unlimited-growth school of thought, represented by the Cato Institute, The Heritage Foundation, and the Julian Simons of the world, are not worried about resource depletion because, they claim, science and technology will create substitutes for anything we need. Neither are they concerned about population growth, because with the help of science, we can feed 10 or 20 billion or more.

Some of this stuff may sound convincing if you don't think about it too hard.

In any event, arguing about how many people the world can feed is a meaningless exercise. The important question is, What will be the quality of life if the population doubles or triples? The answer: Life on the planet will continue in some sort of condition regardless of population levels, but certainly not in a condition that we would find tolerable.

In the debate over population, the country seems to divide roughly into three groups:

Group One
: Those who are alarmed by the prospect of continued exponential population growth;

Group Two
: Those who are alarmed that Group One is alarmed;

Group Three
: Those who don't give a damn about any of the alarms.

In fact, there is something to be alarmed about; it is called exponential population growth. While an annual population growth rate of 1 or 2 percent looks small, it is indeed quite substantial. A 1 percent annual growth will double the population in 70 years; a 2 percent rate will double it in 35 years; a 3 percent rate will double it in 23-plus years. The current

U.S. growth rate is 1.1 percent per year. At that rate, U.S. population will double in 63 years.

It took 3 million years for world population to reach 1 billion around 1825. Since then, it has taken:

100 years to reach 2 billion - 1925;
35 years to reach 3 billion - 1960;
15 years to reach 4 billion - 1975;
12 years to reach 5 billion - 1987;
13 years to reach 6.2 billion - 2000 (est.)

Those alarmed about world population are strangely complacent about U.S. population. They think population is a problem in China, India, Africa, and elsewhere, but not in the U.S. The facts tell a different story.

Lost in the endless arguments over how many people can be sustained on the planet is another question of greater import; What is the optimum population of the world or the United States? Have we not already exceeded it? What will the world or the United States look like with twice as many people? What will be the impact on the quality of life? On freedom of choice? Let's take a look close to home. What will be the political, cultural, and social consequences of doubling the current U.S. population? The high-range Census Bureau population projection indicates an increase in the U.S. population from 260 million to 522 million by mid-next century.

With twice as many people projected, it will be necessary to double the total U.S. infrastructure in a little more than 60 years. A few examples:

- Twice as many cars, trucks, planes, airports, parking lots, streets, and freeways
- Twice as many traffic jams
- Twice as many houses and apartment buildings
- Twice as many grade schools, high schools, colleges, and trade schools
- Twice as many hospitals
- Twice as many prisons

In short, twice as much of everything.

What happens to wildlife habitat? Population growth has already destroyed half the nationUs wetlands and a major portion of habitat for birds and other animals.

There is something wrong with a society which remains complacent while this kind of irrational destruction erodes its life-sustaining resource base. With twice the current population, will there be left any wilderness areas, remote and quiet places, habitat for song birds, waterfowl, and other wild creatures? Certainly not very much.

New cities, suburbs, housing developments. With double the population, it will be necessary to take over and develop in the next 50 years an amount of farm land and scenic countryside equal to the total already developed in the past 200 years. That will be the case if we continue to utilize land in the future as we have in the past. The result will be an urbanized area of some 312,000 square miles; an area larger than Wisconsin, Iowa, Illinois, Indiana, Ohio, and Michigan combined.

National Parks, National Forests, Wildlife Refuges, BLM Lands and Wilderness Areas. With twice the population, what will happen to the last of our great natural areas, which are already experiencing serious degradation from population pressures? The short answer is, they will be gone; rare and special places like our national parks and national forests will evolve into modified theme parks and Disneylands. The process is already under way.

Look at the numbers. Annual National Park visitations, for example, have ballooned since 1950 from 30 million to almost 300 millionQa tenfold increase in 45 years. The park system is already in a state of decline and deterioration from people pressure and commercialization. What will this remarkable natural heritage be like and look like when visitations double or triple in the next couple of decades?

Will the quality of life be better? With twice as many people? Will mega-cities twice the size of New York, Miami, Chicago, Detroit, and Los Angeles be more manageable, more livable, and safer? The answer is obvious. Some are already borderline ungovernable. The question is this: Do we have the wit clearly to perceive the long-term implications of continued exponential population growth soon enough to effectively address that issue within our own borders?

Mainstream economists have dominated economic thought with comfortable assurances that there is no foreseeable limit to economic expansion; that exponential population growth is an asset, not a liability.

It is little wonder that the economics profession, except for a small number of resource economists, has made itself irrelevant to the central issue of our time. The extent of their irrelevance was aptly put by Amory Lovins when he said, "economists are those people who lie awake nights worrying about whether what actually works in the real world could conceivably work in theory."

Ironically, an issue of at least equal importance to population is rarely noted or mentioned anywhere. Yet, it is the key to our environmental future. The absence of a pervasive, guiding conservation ethic in our culture is the issue and the problem. Society's answer must be to focus its attention and energies on nurturing a conservation generation imbued with a conservation ethic. Without such a guiding cultural ethic, society will not have the understanding, motivation, conviction, or political will to persist in addressing the truly hard questions that will confront us in the decades to come.

Fortunately, there are encouraging signs that we as a society are rapidly beginning to develop a conservation ethic that will ultimately flower into a powerful social, political, and economic force. The sooner the better.

We are dealing with a social, ecological, and economic challenge unlike any other in our history. It is a challenge that begs for the kind of dedicated, inspirational leadership provided by Franklin Roosevelt and Winston Churchill in their pursuit of victory in the Second World War. This challenge is far more serious than the military threat to the democratic West in World War II. Nations can recover from lost wars; witness Germany and Japan; but there is no recovery from a destroyed ecosystem.

The opportunity for a gradual but complete break with our destructive environmental history and a new beginning is at hand.

Reaching a general understanding that sustainability is the ultimate issue will finally bring us face-to-face with the political challenge of forging a sustainable society during the next few decades. It is a challenge we can meet if we have the leadership and the political will to do so. Indeed, none of the so-called sacrifices required to forge a sustainable society would be considered unduly burdensome by our grandparents. We have evolved willy-nilly into a frenzied, consumer throwaway society, and in the process, we are dissipating our sustaining resource base.

As we contemplate our consumer throwaway society, we are reminded of a comment by Socrates, who died in 399JBC. Asked why he bothered to regularly visit the open market when he never seemed to buy anything, he replied that he did so because he was always amazed by how many things were for sale that he didn't need.

The bottom line is this; a sustainable society at some bare subsistence level will ultimately evolve even if we as a society simply do nothing. Unfortunately, at that stage we will end up debating over earth-friendly solutions to scarcity.

All of this will be enormously complicated and controversial far beyond anything ever before attempted. The debate and controversy are vital to the process of developing public understanding and support for making the hard decisions and the right decisions. If we fail to make the necessary decisions, nature will make them for us and for all future generations; but there is no good reason to fail, provided the public does its part and the government assumes responsibility for enlightened leadership.

Gaylord Nelson, the former Governor of Wisconsin and founder of Earth Day, addressed the participants of the Fifth National Citizens Environmental Monitoring Conference and urged volunteer monitors to advocate for sustainable prosperity.

CONCURRENT SESSION 1

Workshop Leader: **Sharon Behar,** River Watch Network

Sharon Behar
River Watch Network, 153 State St., Montpelier, VT 05602, 802/223-8082

In most cases, environmental and conservation organizations need to create vital and long-lived groups in order to address a community's needs. Usually, the efforts to monitor and improve water quality, prevent a new source of community pollution, build an environmental educational program, protect community land resources, create economic viability for a community, etc., take much longer than two to three years. To have true impact and then to maintain what has been won or created, these efforts require groups who can sustain their work over a period of 10 to 40 years.

What does it take for environmental, conservation, and community groups to create organizations that can truly sustain themselves and their critical work for the long haul? How can current volunteer and staff leaders modify and structure their work so that future leaders will have a dynamic and stable organization? What types of processes enable groups to adapt and change in accordance with the needs and context of their community issues?

The following "ingredients" are one outline for organizational leaders to consider as they grapple with these questions and seek to create sustainable organizations.

Ingredient #1: Strong programs with a clear focus

The program of your organization or your project is at the core of your success. A good program attracts people, which then attracts funding. Programs must serve a need, be well thought out, be doable, and have the ability to involve many people. Sustainable organizations are able to take a program idea and implement it by creating a strategy with measurable steps. In our changing world, sustainable organizations are able to assess crucial program factors regularly and change approaches accordingly.

Ingredient #2: Strategic planning that involves many and gets used

An organization's purpose and goals are the magnet for the people, resources, and money that are needed to make the organization effective. Whether the organization is clarifying goals for the first time, or is determining a new focus after years of operations, a strategic plan is critical to success. Good strategic planning involves all the key players in the organization, plus possibly people you serve and those you wish to collaborate with. The planning process will include discussion of and decisions on the organization's mission;

3- to 5-year goals; objectives or strategies for each year that will move the group toward its goals; and a day-to-day workplan that implements the objectives. The strategic plan, once created, becomes an operations plan that should be used regularly (at least quarterly) to measure the organization's progress and then to make adjustments as needed.

Ingredient #3: Key active people and volunteer leadership development

The "people resources" of an organization consist of volun- teers and staff. Regardless of whether an organization has staff or not, a sustainable organization has key leaders, active people at all levels, and a way to develop leaders throughout these different levels.

Opportunities for participation at all levels are important: from first-time volunteers at an event to working committees; from getting a mailing out to speaking at a public hearing; and from participation in an outing to serving on the board for the first time. An organization may harness an individual's interest in and commitment to the organization's mission, and then match the individual's availability with the work that needs to be done. This includes cultivating and training volunteers as well as developing leaders.

For organizations that have staff, attention to hiring professional staff and creating a healthy working environment for them is key. On a day-to-day basis, staff are often the most visible players on behalf of an organization's mission and goals. Once staff (or leading volunteers) are engaged, systems to create clear expectations, workplans, evaluation procedures, and personnel policies are key to seeing this investment mature and grow over time. Staff (or the lead volunteers) also need professional development (training, new positions, cross-training, etc.), an abundance of positive feedback, and policies that support their administrative and program work and help motivate them on a day-to-day basis. These are key elements for volunteer development as well.

Ingredient #4: An effective governing body

The governing body of a nonprofit is called a Board of Directors; for a monitoring project, it is the Steering Committee. This governing body helps to create a larger group of people who are invested in the organization. In our experience, volunteer monitoring projects that do not have a Steering Committee dissolve when the key leader leaves. Organizations without effective Boards of Directors are limited.

The Board of Directors or Board of Trustees is legally and ethically responsible for an organization and its effectiveness. Every Board of Directors works a little differently based on how it was founded, its age, the size of the organization, the types of programs, and the availability of staff. Most effective governing bodies, however, carry out at least the following responsibilities: (1) determine program and budget, (2) see that the program is carried out, (3) give and get money, (4) support public relations, (5) choose, support, and evaluate lead staff, (6) replace and train themselves, and (7) evaluate the organization's effectiveness.

The Steering Committee is not a legal entity, as is the Board of Directors. However, its role is similar in that it helps determine program and budget, assess the effectiveness of the program, support and develop the lead volunteers, and create visibility in the community.

Ingredient #5: Diverse fundraising efforts

The most stable and sustainable biological systems have often evolved with an amazingly diverse number of species. Likewise, sustainable organizations need diverse sources of income in order to weather the harsh "drought years" and the pestilence of a changing economy. Solid fundraising efforts create plans to have money coming in from as many places and as many people as possible, and for sources to be added every year. In addition, the fundraising efforts are led by a diverse pool of people within the organization so that ownership and expertise are shared.

Ingredient #6: Clear and accurate financial management

Clear and accurate financial management provides the needed management tools for decision-making and planning for the future. The Board of Directors (or Steering Committee in an all-volunteer project) and the Executive Director (or project director) have the responsibility to create and manage the following elements of a good financial system: (1) a complete and conservative budget, (2) correct accounting records, (3) timely financial reports (at least monthly), (4) financial reports in an understandable form, (5) projections and budget revisions when needed, (6) compliance with government reporting and deadlines, (7) checks and balances, especially for cash management and check signing, (8) adequate insurance coverage, and (9) an adequate filing system.

Ingredient #7: Clear communication and a "learning environment"

In natural biological systems, adaptation cannot occur without a feedback loop. Sustainable organizations model this biological wisdom by consistently creating opportunities for learning and change to occur. Practices such as written and verbal evaluations of meetings and training programs, periodic program reviews, and annual assessments and evaluation processes provide a constant feedback and learning loop. By regularly and openly asking "How are we doing?" organizations create an organizational culture where actions are not "mistakes" or "wrong," but instead are an opportunity to learn how to do things better for the next project or the next step.

Ingredient #8: Community networking and visibility

Strong partnerships with a broad base of other organizations help to build visibility for the organization in the community and smooth the way for implementation of action projects. Networking and collaboration will vary according to the organization and type of project. Collaborations can include businesses, clubs, schools, agencies, key decision makers, and other organizations.

Organizations need to let the community know what they are doing (program) and that the community is welcome in every stage of a project (volunteers). An important component of visibility is the cultivation of media coverage. In addition to media coverage, organizations have a large variety of tools for providing information about their projects to a lot of people. Examples include: holding special events, postering, setting up a table at a local fair or at the library, and presenting the results of your monitoring program by giving presentations to groups (e.g., Rotary Club, Conservation Commission). Don't forget the power of word of mouth as volunteers talk with friends and family. It is important to make sure your volunteers are kept informed about the most recent events and issues.

The above framework was adapted from work with The Institute for Conservation Leadership, 6930 Carroll Ave. Suite 420, Tacoma Park, MD, 20912, 301/ 270-2900.

Effective Use of the Media

Moderator: **Barry Tonning,** Gateway District Health Dept.
Speakers: **Barry Tonning,** Gateway District Health Dept.;
Kristin Merriman-Clarke, American Fisheries Society

Barry Tonning
Gateway District Health Dept., P.O. Box 555, Gudgell Ave., Owingsville, KY 40360, 606/674-6396

Creating a Ripple Effect on Watershed Issues: The Care and Feeding of Reporters

Limited financial resources demand that water monitoring and nonpoint source (NPS) programs get "the most bang for the buck." Since many aspects of NPS pollutant elimination involve informing and educating various publics for the purpose of modifying personal behaviors and commercial activities, it is essential that a conscious, planned public information and education process accompany NPS and other watershed remediation projects.

Furthermore, by communicating directly with the public through its media, we can put information into the hands of the ultimate decision makers, and provide a venue for reporting some data (such as volunteer monitoring results) that may get "lost in the shuffle" by local reporters, politicians, or bureaucrats.

The idea of dealing with the media may sound formidable--even threatening--to volunteers unaccustomed to reporters, as well as to staff and consultants more comfortable plying their trade quietly behind institutional public information policies. Indeed, most of our public information and education thus far has been disseminated through carefully composed brochures, pamphlets, slide shows, and videotapes aimed at targeted audiences. However, in order to reach the masses of people who need to be informed on water quality issues, we must preach to the sinners as well as to the choir.

Therefore, telling the local watershed story to the local press is important. And despite the normal fear of reporters, cameras, and microphones, it need not be an unpleasant experience. Using the mass media--radio, television, and newspapers--is a powerful and very inexpensive way to get the water quality message across to the huge numbers of people who need to be exposed to it. Familiarity with the basic principles of communication--and the needs of the media--is all that is required to understand how this vital public information and education service can be employed to help clean up the nation's waters.

What the media want from you

Although there are considerable differences among newspapers, radio stations, and television stations, all three share some important similarities:

1. **They want a story.**

   It can be anything--"Agency Concerned about Siltation in Rolling River"; "Group Seeks Funds to Clean Up Goose Lake"; "Citizens Urge Study of Livestock Impact on Bear Creek." A good story can be developed from nearly anything related to watershed work. Feature stories on volunteer monitoring activities and/or data reporting are excellent examples. Just because no major event (i.e., grant award, enforcement action, hospitalization, death) has occurred doesn't mean that a story is unwarranted. Indeed, much of what's covered in the "news" consists of press releases from various sources. Your watershed story can be about anything, but it has to be about something. Focus it. The story is the most important thing to consider: it will dictate what kind of coverage is devoted to your message. A dozen or more stories can be developed from nearly any project that lasts 12 months. Weekly updates or even weekly columns present an excellent format for continuing coverage. And remember: news consists of the good, as well as the bad and the ugly. Feature stories on successful solutions are great ways to cover NPS issues in a positive light. In fact, focusing on real, achievable solutions implemented by the wide variety of runoff pollution players often provides the best format for presenting the technical details of the problem, its impacts, and possible solutions, while at the same time improving science literacy among the public.

2. **They want a local angle.**

   Don't send them a general press release from some national or state office and expect them to localize it. That's your job. Take them out to film some badly eroded river or creek banks. Call the water plant and get the manager to talk to a reporter about the effect of solids on treatment costs. Have a few fishermen on standby who can talk about spawning bed siltation problems, or the effect on macroinvertebrates (fish food). Feature a local farmer who has just installed a new animal waste system. Do a story on the wide availability of oil recycling options, and the effects of dumped oil on surface and ground water.

3. **They want you to do most of the work.**

   Face it: reporters are trained in retelling a story. You've got the story, they've got the expertise and the means to retell it. Don't expect them to sift through two-inch-thick documents on impaired uses of surface waters--compile the information for them. For best results, consider writing up the story yourself! It's not too difficult, and you'll be making sure that the story says what you want it to say. Tell them (or better yet, show them) where to take pictures or videotape. Give them the names and phone numbers of people to interview. Make it easy for them, so easy they can't resist running your story--and so easy that they'll call you when the news is slow (summertime) and they need a story. Finally, develop a personal relationship with the press. Faxes and phones are nice, but there need to be faces and people behind them. Developing relationships early will ensure that you'll be called to comment on breaking news stories or to put the local spin on regional or national developments.

   A wide-scale effort to utilize the mass media in watershed projects will mark a considerable transition from the current approach, which usually involves media coverage based on a significant (and usually very public) event. This type of coverage is most often about a point source, and is generally negative: fish kills, oil spills, etc. What's lost in event-based coverage is the significant contribution of nonpoint sources to water quality degradation, and the positive message that solutions exist; the public education function is not fulfilled. The limited NPS news that has been covered in the local/mass media seems to lack the local angle, probably due to its origin as a regional or national press release.

   The format for these releases is pretty straightforward: a "headline-able" news nugget, followed by some detailed information about the issues at hand, written in layman's terms. (Important note: calling phosphorus "P" in a presentation, as in "P is one of our biggest water pollution problems," may lead to some rather gross misinterpretations of what you're talking about.)

   Obviously, institutional barriers to open communications--if they exist--need to be addressed. Of interest in this regard is EPA's brochure (EPA-87-020) entitled "Seven Cardinal Rules of Risk Communication." Rule Number One: "Accept and involve the public as a legitimate partner... The goal of risk communication should be to produce an informed public that is involved, interested, reasonable, thoughtful, solution-oriented, and collaborative; it should not be to diffuse public concerns or replace action."

   A final note: use common sense. Cows standing in a creek can be photographed from the public right-of-way, so there's no need to trespass. And avoid naming names. Identify problem areas by watershed, not by landowner. The only exception is a story on an enforcement action, which has vast deterrent potential and should be tastefully, but definitely, publicized.

Communicating to change behaviors

The reasons for advocating more news coverage of watershed issues are: (1) to inform the public about the extent of the problem, and (2) to educate people on how to eliminate the problem. Both, of course, imply an underlying goal of prompting action. Communicating to produce a desired action requires a clear, concise message; repetition of the message employing varied approaches; and linking the message to something the audience values. By taking local watershed and nonpoint issues directly to the locals through their media, you will help create an awareness and understanding of the problem among the ultimate decision makers, and also build public support for policies that address pollutant reduction and remediation.

Kristin Merriman-Clarke
American Fisheries Society, 5410 Grosvenor Lane, Suite 100, Bethesda, MD 20814, 301/897-8616 ext. 220

Media Strategies for Cheapskates

Why should you have a media strategy?

A survey three years ago found that 81% of Americans get their environmental information only from the news media. In 1993, readers responding to 10 newspaper studies identified environmental issues as the fastest-growing topic of news interest. In every major media market, interest in environmental news ranked in the top 25% of all topics tested. In response, environmental coverage is increasing across the country.

In 1994, the Foundation for American Communications (FACS) published a survey of 512 newspaper and TV reporters and editors that showed environmental coverage had expanded by 46% in the past two years. In fact, every very large newspaper in the United States has at least one reporter assigned to the environmental beat. Sixty-eight percent of medium and large newspapers--and even 38% of small newspapers--also have at least one such reporter. In addition, one-fourth of local TV stations have someone specializing in conservation stories.

This is all good news. The bad news is that 72% of reporters say that they think reporters lack the training and background needed to cover environmental issues well. In fact, only 2% of the surveyed environmental reporters had studied science in college. Another problem the survey revealed was that more than half the reporters had trouble finding experts who speak in plain English rather than scientific jargon and who also are not biased toward environmental activism or business. So the good news is that media want conservation stories; the bad news is that they don't know what they're talking about or where the stories are.

That's where you all come in. News coverage for your group can translate into many benefits, including:

- free publicity for events, products, and meetings
- new members
- increased community support for conserving streams and water resources
- visibility as a source of scientifically based water quality information
- better public understanding of your organization, its goals, and its involvement in local conservation issues
- pressure on public officials and other policy makers to act on a problem.

Why are you newsworthy?

I am always being told by scientists and grassroots activists, "We're not doing anything that is newsworthy." I go crazy trying to convince my own members, who are fisheries scientists, that what they do is news. True story: Two of our members were driving back from a chapter meeting and saw smoke coming out of a hotel. They stopped and ran in, woke up and evacuated everyone on the floor, called the fire department, and rescued a mother and child who were almost overcome by smoke in their burning room. The chapter ran a blurb about it on the second-to-last page, after the call for papers for their meeting next year! And the members were surprised that I called them for a story! It's an extreme example, but I'll tell you what I tell them.

First, a local angle is essential even when a reporter is writing for a national publication or network. You as a local citizen and group can be that angle, as can the issue or event you want covered.

Second is the matter of timeliness. You should keep up with trends in environmental and community news coverage so that if you see a story on, say, reauthorization of the Clean Water Act, you can call the reporter about a follow-up article on the effects of water pollution on local streams or rivers. Tie your group's activities in to current news.

Third, you are newsworthy because you have good data and experience and can give interesting quotes. You just need to decide which facts and focus will best "hook" a journalist's interest. Say your group is starting a riparian restoration project. Outline details such as why riparian zones are important, why your group decided to take on the project, whom you hope to involve locally, which waterways you are working on, and what the heck a riparian zone even is. Avoid jargon like "riparian zone" in your statements. I talked to Save Our Streams guru Karen Firehock the other day about this presentation, and she suggested using analogies and making the issue relevant. The statistic she likes to use is that 50% of Americans get their drinking water from surface water, and in many cities that figure is 100%. Therefore, stream pollution should be relevant and of great importance to anyone who drinks a glass of water.

Fourth, you're newsworthy because you can provide specific examples of, and possible solutions to, a local problem. You remember the 98% of reporters without a scientific background? Take a journalist to a healthy stream and then to one that is polluted or of lesser quality. Show her how to use a kick-seine, fill out a bug card with him, point out eroded streambanks and sparse vegetation. Provide helpful details such as how to

recognize good and poor qualities in streams, and then describe what local citizens can do.

In that 1994 FACS survey, reporters said they use environmental and consumer activists or government as sources 80% of the time. However, in order to gain this attention, you must use different approaches with different media.

Strategies

Okay, you all know now that you are newsworthy, but you're broke. Who cares? Forget all those glossy media kits, all those expensive video news releases, etc. You don't need 10 grand to get a reporter to call. Most of your cost is in time.

First, make a complete list of all local newspapers and magazines (daily, weekly, and monthly), TV, and radio stations. The aim is to make "contacts"--editorial page writers, local news broadcasters, journalists who regularly cover the environment or community beats. Your local library should have two reference books that make this job easy: the latest issues of Editor and Publisher Yearbook and Broadcasting Yearbook. Both list, by state, all the media outlets and their addresses, phone numbers, and even the beat reporters' names. Don't forget to add any publications distributed by state natural resources agencies and commissions. Look in the blue government section of the phone book for those numbers. Also, list any wire service correspondents and freelance outdoor writers who have written about or shown an interest in streams. You can also check on whether your state has an outdoor writers group. The Association of Great Lakes Outdoor Writers, for instance, has 350 members. Call the Outdoor Writers Association of America at 800/692-2477.

The cost of this part of your strategy is zero, except maybe one or two long-distance phone calls.

Second, appoint one of your members or officers to be the media liaison. This member is responsible for developing regular contacts with journalists, maybe inviting them to attend your organization's meetings or events. Reporters are more likely to call people they know and trust for information, so mail them copies of your newsletter and offer yourself as a "source." Make sure your organization has clearly chosen its position. A unified front is the best front.

The cost to you? Again--zero.

Third, make a list of events or products you want the media to cover this year. This is an annual exercise. Ideas might be officers' elections, reports, proposed legislation, monitoring events, training sessions, group anniversaries, annual cleanups, a new fact sheet, whatever.

Cost to do this: zero.

Fourth, in addition to your list of story ideas, decide whom you most want to reach and what your key messages for the year will be, then build a strategy around getting the messages out to those people. Decide what media would be most likely to cover it--for visual activities like stream cleanups, think TV as well as newspaper. For a new fact sheet, go with a weekly or daily paper. For a major report, try the state wire service and state papers. You can save money for your group by doing targeted media outreach. Don't just send a release to anyone.

Now, in putting together your strategy, please think about the following approaches. First, let's talk about newspapers and print media. Regardless of what you read on the Internet, print publications are not dead. In 1996, the number of daily newspapers was 1,532. Weeklies totaled more than 5,000. One newer medium is on-line newspapers and magazines. The number of on-line newspapers tripled last year to 175 and might total 350 this year. Their audience is almost limitless. Seek out these publications and add them to your media list.

One of the most important tips I can give you in terms of involving newspapers in your media strategy is to give reporters from different departments of the newspaper different stories. That means pitch a feature story to the feature editor--say, a story about a senior citizen who is helping to restore important stream habitat and convince other seniors to get involved in conservation. Senior citizens are terrific demographics for newspapers and advertisers; papers like old people. The same goes for children--kids sell. Is there anything better than a big photo of a grinning boy eagerly showing off a crayfish he found under some stream rocks?

Then pitch a news story to the news department--on something like sediment problems caused by development near local Jones Creek. That might end up in the front or metro section. Next comes an outdoor story about what a great family activity stream monitoring can be, and showing anglers and boaters getting involved. This might end up on the Sunday outdoor page in the sports section.

You can even try the business editors with a pitch about something like the increasing cost of flood insurance due to diminished numbers of naturally protective wetlands--or, on a positive note, how greenways and healthy streams can add value to homeowner property. Even the crime reporter could find a story in whether state laws are being enforced to require developers to construct barriers to prevent sedimentation of nearby streams.

In addition to these newspaper sections, don't forget the easiest way to get in the paper: write a letter to the editor. Besides the front page, the letters page is the most-read page of the paper. You can also contact the editor about writing a short opinion piece.

Another idea: the 1993 FACS survey found that few environmental stories discuss the health risks or economic consequences of environmental decisions. So if you can find an angle along those lines, pitch that as well.

I also want to point out that if you are an urban stream group, you should know that TV and print media are hungry for positive stories about minority groups and individuals. Sadly, a recent study prepared for the National Association of Hispanic Journalists shows that only 1% of news stories are focused on Latinos and issues related to Latinos. Of those, 85% focused on crime, immigration, affirmative action, and welfare. Yet the U.S. census predicts a huge growth in the Latino population in the next decade, so media and advertisers are eager to reach these consumers. The same with African-Americans. Media outlets such as Black Family Today, a bimonthly magazine in Florida that covers African-Americans at work and play, are excellent possibilities for coverage.

I strongly urge you all to consider creating a Rolodex card that you mail to reporters each year. You write the text, and then for around $25 $30, you hire a graphic artist to design the card. To print up 500 Rolodex cards in Washington, DC, where you're sure to be gouged, costs less than $100. I'm sure it's cheaper elsewhere.

Now I'll turn to TV and cable. I confess a bias against them because I think many TV reporters are lazy and use the evening news to entertain rather than inform. Essentially, if you get covered by your local or state newspaper, you likely will get a call from a TV station. In May, a company called Wirthlin Worldwide surveyed a group of TV journalists about how they come up with their stories. Almost one-third of them said they used the newspapers often, very often, or all the time to determine what to cover. Another 47% admitted that they occasionally use newspaper articles to determine what to air. Personally, I think they're lying--if more than five minutes of a newscast is devoted to original stories I'd be surprised.

For you, though, this follow-the-lemmings attitude is good--if you get into the newspaper first. What's really going to help you get airtime is how visual your water monitoring activities are. Unlike the talking heads of politicians, you all are out there, feet wet, in the picturesque stream, holding intriguing, scary-looking bugs--and you might be only six years old! Or 96! Either way, you're local, you're timely, you've identified a problem, and you've got recommended solutions. You're news! So when you're thinking of pitching a story to TV, think about how to get your message across visually.

Cable TV represents the future of communication: reaching niche audiences. Don't ignore this outlet. Many cable stations have local talk shows that want local people to discuss local issues. Call them and offer to be a guest. This is a great way to get TV experience before pitching to the network affiliates. It also is especially good at reaching minority and international groups, so you should identify members in your group who speak other languages and can reach a multicultural audience in your community.

Another way to use cable is to ask a college communications class to prepare your group's PSA as a project. Students can write and produce the PSAs for you for free or a very low fee; then you only have to deal with distribution. Try to tie in your TV PSAs with your radio PSAs. Using multiple media outlets at the same time strengthens the message impact.

Radio

Radio is great. It's underused by environmental groups, but the potential audience is tremendous. It's also very easy and inexpensive to get coverage. You have several routes:

1. Write up a few PSAs about different issues or problems that relate to the station's audience, maybe a PSA about frugal use of lawn chemicals to reduce runoff or one that has five tips on how citizens can conserve water. Write up a 10-second, 30-second and one-minute spot on each topic, practicing each aloud and timing it for length. Write a cover letter introducing your group and why it wants the station to run the spots. Include the scripts and a self-addressed, stamped postcard or envelope and ask stations to let you know if they will use the PSAs or not.

   Your media list of radio stations should focus on station formats geared to talk, news, public access, country-and-western, and middle-of-the-road. I've had good success with these formats.

2. You can produce the spots yourself on tape. Go to a commercial audiotape place and ask for recycled tapes, which are cheaper. Ask a local university or taping company to donate 15 minutes of studio time to produce the tapes. Students can be helpful with the how-to. The problem is that this approach costs more and also doesn't contain the station's radio personality, who always has a better chance of getting airtime. This is a good choice, though, if you have a celebrity willing to be the voice.
3. Pitch stories to the radio news reporter and offer to take her out for a monitoring demonstration.
4. Keep a list of all local radio talk shows and contact appropriate ones for a possible guest appearance. Call-in shows are particularly good and often have large listenerships.

   Another tip I want to share about creating a media strategy expands on a point I made earlier regarding the student-produced PSA: Let others do your work. When I was at the Izaak Walton League, we had to raise $350,000 to buy a helicopter for Fish and Wildlife Service to stop duck poachers in Louisiana. I asked senators and congressmen from the state and throughout the duck flyway if they'd be willing to do a public service announcement for TV about the effort. Every one said yes. We wrote up the scripts, and their offices produced the spots, distributed press releases about them, satellited the PSAs to every TV station in their state, and even used the voice-overs as radio actualities, which they also distributed free for us. Legislators in your state might be willing to do something similar, perhaps for National Wetlands Month, especially during this election year.

   When I handled media as a volunteer for the Alzheimer's Association, I often turned to the local Chamber of Commerce or Lions Club for outreach help with our annual walkathon. The chamber had excellent press lists and contacts, and because their members wanted to participate, they sent out their own press release

about the event. Thus, the media received two press releases from two different groups--a double hit to get their attention.

I want to conclude by urging you to be proactive rather than reactive with the media. By taking time to think through media opportunities, you're more likely to generate positive coverage and have a say in responding to negative stories.

Restoration 101:
Planning Restoration Projects

Moderator: **Karen Firehock,** Izaak Walton League of America
Panelists: **Karen Firehock,** Izaak Walton League of America; **Dennis O'Connor,*** Restoration Ecologist

Karen Firehock
Izaak Walton League of America Save Our Streams Program, 707 Conservation Lane, Gaithersburg, MD 20878, 301/548-0150 or 800/BUG-IWLA

The Stream Doctor Project

Stream Doctor is the watershed restoration project of the Izaak Walton League of America's Save Our Streams program. Stream Doctor helps people diagnose stream problems, write a prescription for recovery, and initiate a physical fitness program for long term care.

Stream Doctor takes a holistic approach to stream health, which includes the chemical, physical, and biological health of the stream. Stream Doctor helps volunteers first assess the health of their stream by looking at how well the stream is able to support optimum physical, chemical, and biological values, and then take steps to help the stream recover.

Stream Doctor involves looking at all aspects of the watershed and determining what is achievable for your stream. For example, if 60% of the watershed is covered by impervious surfaces, such as roads and rooftops, bringing back trout is probably not a realistic restoration goal. However, improving public access, managing groundwater, and planting trees may be feasible for your stream.

Stream Doctor uses techniques such as bioengineering to help Mother Nature heal. Bioengineering involves the use of woody vegetation with deep and branching root systems in concert with specialized planting patterns or other structural support, such as logs, to help anchor vegetation in place. Streams are dynamic and do not function properly when they are constricted. These life systems are able to move and adjust to changes in stream flow, shape, and function and also provide other benefits such as fish and wildlife habitat, filtering of polluted runoff, bank stabilization, and aesthetic values.

The most important aspect of the Stream Doctor approach is partnering. Stream Doctor does not advocate volunteers or amateurs taking on a restoration project. Rather, Stream Doctor encourages volunteers to enlist appropriate technical expertise to design a project, apply for necessary permits, build and install restoration plantings, and monitor and maintain the project.

Slide show script

Note: Karen Firehock's conference presentation consisted of a slide show. Following is a slightly modified version of the script that accompanied the slide show. Save Our Streams: Save Our Streams (SOS) is the national stream monitoring and restoration program of the Izaak Walton League of America. The League is a national nonprofit conservation organization of 50,000 members dedicated to the conservation of America's soil, air, woods, waters, and wildlife. The League works on a variety of conservation issues including outdoor ethics, sustainable communities, clean air, clean water, and restoration of public lands. SOS was founded in 1969 to help League members and the public learn to protect and restore America's streams and was spread nationwide through the Water Wagon, which traveled to the lower 48 states teaching people how to monitor and protect their rivers.

Stream Doctor: Prescriptions for Stream Health

- Examine Your Watershed
- Diagnose Your Stream's Health
- Cure Your Sick Stream
- Provide Long-Term Care

STEP ONE: Examine Your Watershed

Watershed Boundary Map: The first step is to learn your watershed address. A watershed is an area of land that drains to a particular stream, river, lake, or estuary. Watershed Mapping: Use topographic maps to determine the land that drains to your stream. Streams are the true landscape architects, carving out valleys, floodplains, and landscape features. Determine the watershed area of your stream and inventory the existing land uses.

Stream Survey and Inventory: Walk your stream and record the condition of your stream and its watershed. Work with other stream partners and enlist technical expertise from government agencies, businesses, schools, and volunteers.

Healthy Stream: A healthy stream has good instream habitat for aquatic life and fish, such as overhanging vegetation, woody debris or rocks, and organic matter. The floodplain is the flat area adjacent to the stream and plays a vital role in stream health. Flood plain vegetation, such as trees and woody shrubs, provide

shade to keep the stream cool and oxygen levels high. Roots from vegetation also filter pollutants from rainfall runoff and groundwater.

Stream Features: Identify and map physical features in your adopted stream segment such as point bars, riffles, floodplain areas, pools, sand bars, and meanders.

Bank Full Area: In a stable stream you will recognize low areas where the stream has carved a shallow floodplain.

Riparian Zone Vegetation: A healthy stream has a buffer of native vegetation on both sides that provides stream shade and wildlife habitat, and filters polluted rainfall runoff and sediment.

Animals: Streams also provide habitat for animals and a vital corridor for wildlife. Look for signs of animal life such as animal tracks. Beaver also rely on streams for habitat. Trees provide food for the beavers.

Nonpoint Source Pollution: Stream Doctors also look for runoff pollution coming from the land, such as erosion, spills, or illegal dumps.

Urban Areas: In urban landscapes, large paved areas prevent rainwater from soaking into the ground. Instead, rainwater runs off the streets in great volumes and high velocities, carrying with it pollutants from the streets.

Storm Drain: Rainwater runs into storm drains and carries pollutants, such as oil, into the sewers and into streams. Cities and parishes of greater than 100,000 people must begin to treat the sources of this runoff under the 1987 Clean Water Act Amendments, but most cities are a long way from meeting this goal.

Streambank Erosion: High volumes of urban stormwater can enter creeks with great velocity, gouging out the bottom of the streambank and causing streambanks to collapse. Walk your stream to look for problems such as streambank erosion. Eroding streambanks can contribute over 40% of the sediment entering streams. Excess sediment can clog fish, smother bottom-dwelling insects, and block light to underwater plants.

Floods: Floods can also cause streambank erosion. Flooding is a "natural" event and serves an important role in depositing nutrient-rich soils along floodplains. However, the frequency of large floods can increase when land is cleared for development, tree harvesting, or farming. The draining of wetlands can also increase downstream flooding because rainwater is no longer stored in wetlands.

Point Source Pollution: Stream Doctors search for pollution problems in their watershed, such as point source pollution from pipes, and determine what type of

discharge is coming from the pipe. The types of pollution will be different depending on whether the pipe drains a farm, a shopping mall, or a factory.

STEP TWO: Diagnose Your Stream's Health

Kick-Seining: Volunteers can use a fine mesh net known as a kick seine to trap stream organisms living on rocks, submerged roots, silt, and logs. Instructions in the SOS kit and SOS handbooks tell you how to collect your samples, and how to identify aquatic organisms such as insect larvae and crustaceans to help you find out if the stream is clean enough to support a healthy aquatic community.

Dip Netting: In muddy-bottom streams in coastal or low-lying areas, a D-frame net can be used to collect organisms from submerged roots, woody debris, organic matter, and stream bottom.

Bug Picking: Next you will pick aquatic larvae from your net to determine what you have in your sample, and then use the SOS bug card to identify your sample. The presence of macroinvertebrates will help you determine if the stream is healthy. A healthy stream has a variety of stream macroinvertebrates and crustaceans, most of which are in the pollution-sensitive category.

Stonefly: The stonefly is a very pollution-sensitive organism. The stonefly has two tails and two antennae, has gills on the upper part of the body, and is smooth on the lower half.

Aquatic Worm: The aquatic worm is very pollution-tolerant and can live for a few days with no oxygen at all.

Chemical Monitoring: Volunteers can conduct simple chemical tests, such as tests for dissolved oxygen, pH, and temperature, to learn about stream water quality. Kits designed to be used by laypersons can be purchased from several companies.

Stream Vegetation: Stream vegetation can provide clues to stream health. This slide shows a liverwort growing on a rock, indicating a healthy stream. In fact, trout were congregating just below.

Stream Channel Morphology: Other calculations concerning your stream's channel, gradient, substrate, and streambank erosion should also be conducted.

STEP THREE: Cure Your Sick Stream

People Working Together: Once Stream Doctors have inventoried watershed land uses and monitored stream quality, it's time to take action! By working together, you can make sure that pollution problems in your watershed are solved. You can work with neighbors, landowners, businesses, and local government to

improve land management practices and regulations and educate the public. For example, you can stencil storm drains to remind people not to dump their used oil. Americans pour the equivalent of 16 Exxon Valdez spills down storm drains every year!

Stream Restoration: Stream Doctors can also perform surgery to help the stream heal. Replanting woody shrubs and using structural techniques such as logs staked into the bank will help the plants re-establish and restore stream buffers and habitat. This technique is called "bioengineering" because it combines live materials with some structural support to help damaged streams heal quickly. Bioengineering does not improve on Mother Nature but helps streams heal quickly from damage wrought by people.

Channelized Stream: One approach to stopping bank erosion is armoring streambanks and bottoms with concrete. This destroys stream habitat and causes water to move downstream faster, causing bank erosion downstream.

Riprap: Stream Doctor does not advocate using riprap to restore stream banks, holes, and gullies. Rip-rap is unsightly, provides no habitat value, and tends to wash away during flooding. It is also expensive and usually requires heavy equipment. Riprap can be used at the bottom of the bank to prevent undercutting in very unstable urban streams.

Stream Slope: Stream slope may have to be changed to a more gentle angle to accommodate plantings and improve bank stability.

Dogwood: Red osier dogwood (Cornus stolonifera) is a frequently used streambank plant. Red osier dogwood grows well in moist soils and provides good wildlife habitat.

Willow: Trees selected for bioengineering should have deep and branching root systems. For example, the black willow (Salix nigra) is native to this area and readily available. Plants for projects should be harvested from the area when they are dormant and installed in the early spring or late fall.

Live Stake: Willows can be used to create live stakes. Dormant willow posts 2 10 feet long and 1 4 inches in diameter can be driven into the streambank, leaving one-third of the stake above ground. These live stakes will sprout roots and form a dense root mass. New willow shoots will grow from the top and shade the stream.

Brushlayer Fill: Small, whiplike cuttings and alternating layers of soil can be used to fill excavated holes. T hese brushlayers create a dense mat of roots and foliage.

Live Fascine: Live fascines are sausage-like layers of dormant cuttings, also known as waddles, that are laid in shallow streambank trenches. Because the

plants are buried, they dedicate most resources to root production during the first year and form a dense intertwined root mass to hold the streambank securely.

Brush Mattress: Brush mattresses are dense mats of cuttings woven together and staked into the streambank. They can be used to cover large bare areas of soil on steeper slopes.

Filter Fabric: Fabric called Geo Jutte is a natural plant fiber used to hold the bank while vegetation establishes. Eventually this biodegradable material will break down and become part of the bank.

Grass: Grass usually is planted over the site to prevent erosion while the cuttings take root and begin to grow. To Restore or Not to Restore: Consider these issues before planning a stream restoration project:

5. Changing stream dynamics. Your stream may be unstable due to land use changes, such as increased paving of upstream areas, that affect your stream's hydrology, causing frequent widening and bank slumping.
6. Extreme stormwater flows. If much of your watershed is paved, your stream may experience frequent flooding. This may make successful stream restoration difficult.
7. Lack of expertise. If you are unable to get adequate information about your stream from government agencies and/or you cannot afford to hire technical consultants, postpone your project until you have enlisted technical assistance.

STEP FOUR: Provide Long-Term Care

A Stream Doctor's job is never done. Stream Doctors work to examine, diagnose, cure, and provide care for their streams on an ongoing basis. Become a Stream Doctor today! Adopt and cure a stream in your neighborhood.

This slide show is funded by grants from the AT&T Foundation, Lowrance Electronics, and the U.S. Environmental Protection Agency. Script and photos by Karen Firehock, Christy Williams, and Julie Vincentz. SOS also wishes to thank the Natural Resources Conservation Service for several slides.

Monitoring Aquatic Vegetation

Moderator: **Linda Green,** University of Rhode Island Cooperative Extension
Panelists: **Elizabeth Herron,** University of Rhode Island Cooperative Extension, and **Stan Nichols,** Wisconsin Geological and Natural History Survey

Elizabeth Herron
University of Rhode Island Cooperative Extension, Watershed Watch Program, 210B Woodward Hall, Kingston, RI 02881, 401/874-2905

Stanley Nichols
Wisconsin Cooperative Extension, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705, 608/262-6556

Aquatic plants serve a variety of ecological functions that are being increasingly appreciated by lake scientists and others with a vested interest in lakes, ponds, and streams. Plants provide habitat, shade, oxygen, and food for fish, invertebrates, waterfowl, and other animals. Aquatic plants also have direct and indirect economic importance. Some species control shoreline erosion, or impact water body aesthetics and use. Species such as wild rice produce commercial products, while Eurasian watermilfoil costs communities significant amounts of money to control.

Aquatic plants are also good long-term monitoring tools. Plants are primarily non-mobile, so they cannot flee rapid environmental change. Many species are perennial, integrating environmental change over periods longer than one year. Plants can integrate the cumulative effects of many disturbances. Aquatic plants respond to nutrients, light, competition or impacts from exotics, and management stresses. Because the ecology of many species is fairly well known, reasonable interpretation of habitat impacts can be made from plant community responses.

Monitoring objectives

The type of information a volunteer water quality monitoring program collects largely depends upon the program's data objectives--in other words, how they intend to use the data. Different uses require differing amounts and types of information. Prior to determining which monitoring protocol volunteers will follow, it's important to identify just what information is needed. If the intention is to pass on the data to other users, it is advisable that those users be consulted as early as possible in the program development process. There are advantages and disadvantages to most of the established plant monitoring protocols for volunteer programs.

Nuisance or exotic plant identification is one of the simplest monitoring efforts groups can undertake. Because volunteers need to be able to identify only one or two different plants, little training is required. Typically, volunteers look for these nuisance species during their usual water monitoring activities, so no additional time is required to perform this type of monitoring. However, while nuisance plant monitoring can be very useful in monitoring and managing the spread of invasive species, very little additional information is collected with this type of monitoring.

Plant bed assessments or general surveys also require little training. This type of monitoring requires volunteers to visually assess and map the type (immersed, submersed, etc.) and extent of aquatic plant beds. Completing a map requires a fair amount of time, especially on larger water bodies. In order to be useful, bed

assessments need to be repeated at regular intervals, such as yearly. Because of natural fluctuations in plant beds, general surveys provide only limited information. They are best used to manage recreational areas, such as beaches or marinas.

Transects, or detailed surveys, require extensive training and time to complete, but provide valuable information on species composition and abundance. This type of monitoring uses maps created through a plant bed assessment to identify areas from which to collect and identify plant samples. In addition to being able to map plant beds, volunteers must be able to identify different plant species and estimate species abundance.

Focused mapping, such as identification of rare, endangered, or invasive species, typically requires more extensive training. For this type of natural history survey, an entire water body needs to be sampled, not just select transects. This requires a greater commitment on the part of volunteers, and may require specialized equipment. The information gathered can be very valuable, and may justify the additional resources if your data needs require such extensive information.

Technology and data preservation

Technology provides some tools which, if properly utilized, may be useful in aquatic plant monitoring. Geographic Positioning Systems (GPS) allow for precise mapping of beds or locations of rare species. Depth sounders or fish finders enable volunteers to map submerged plant beds that may not be visible from the surface. However, both of these systems require a great deal of training to be used accurately for aquatic plant monitoring, and it is very easy to misinterpret the information they provide. Additionally, precise GPS equipment and base stations (for calibration) can be very expensive. As technology improves, it is likely that these systems will become better suited for volunteer programs, and thus gain greater acceptance.

Computer technology has also expanded data sharing opportunities. By posting aquatic plant data on the Internet or World Wide Web, it is possible for volunteer-collected data to be widely used. Due to this expanded use, it is crucial that quality control issues be dealt with throughout the program, and that established protocols for labeling and storing of data sheets and preserved plant samples be followed. Therefore, it is strongly recommended that programs interested in making their data available consult with the scientific or academic community regarding appropriate protocols. Do not forget low-tech data preservation techniques such as maintaining pressed plant specimens in a centrally located herbarium or collection. Herbaria provide excellent opportunities to compare plants across time and regions.

Setting up an aquatic plant monitoring program

There are three key considerations in setting up an aquatic plant training program. First, determine what information is needed. Second, determine how much time you will have, and what resources are available, to collect the information. Third, and of considerable importance, determine how much time and energy volunteers are willing to spend training and monitoring. The answers to these questions will frame the development of the monitoring program.

Numerous aquatic plant monitoring resources and references are available to help in program development. The EPA's Volunteer Lake Monitoring: A Methods Manual, the New York Citizens Statewide Lake Assessment Program Sampling Protocol, the Wisconsin Department of Natural Resources' Aquatic Plant Monitoring Procedures Self-Help Lake Volunteer Training Manual, and the University of Rhode Island Watershed Watch's Advanced Training for Water Quality Monitors: Aquatic Plants Manual can provide useful guidance. In addition, numerous individuals are willing to act as resources. These include federal, state, and local agency personnel; university staff; professional organizations; plant management companies; and environmental groups. The University of Florida Center for Aquatic Plants is a national resource that can help identify potential regional contacts, as well as a wealth of other valuable aquatic plant information. These resource contacts can provide assistance in finding appropriate regional plant identification guides, books, and keys, or suggest monitoring methods and labeling protocols. Often, many of those same individuals will be potential data users, so it is especially useful to have their input as early as possible.

Equipment and expenses

Aquatic plant monitoring equipment needs and costs will vary with data needs and protocols used. Typically, plant mapping tools will include a boat, view tube or diving mask, lake map, range finder, weighted measuring tape or Secchi disk, and possibly a GPS, or depth finder. Plant-gathering tools range from SCUBA to weighted rakes, anchors, or grappling hooks. Often, volunteers already own many of these tools, keeping program costs down.

The time and resources needed to develop and implement an aquatic plant monitoring program also vary. However, expect to devote approximately 10 to 20 hours per week for approximately three months to develop the program. The time can be reduced through efficient use of existing information and resources. For a monitoring program that involves volunteer identification of aquatic plants, it is advisable that multiple repetitive plant identification sessions be held. A minimum of four 2-to-3-hour sessions is strongly recommended. Volunteer time required for data collection will, of course, vary with the type of information being gathered. Training techniques

An effective aquatic plant training program should rely on a variety of training techniques in order to provide sufficient repetition. Also, having several different

people present sessions allows material to be repeated without becoming boring. Generally, introductory sessions held in classroom environments reduce distractions, enabling volunteers to focus on the construction of aquatic plant identification keys, plant ecology, and similar topics. Plant identification from preserved or live species in water-filled trays in a laboratory setting is the next step. Once program participants have gotten comfortable with the subject, it is imperative that training be moved to the field.

Plants appear quite different in their natural environments, and many species look alike. It is important that volunteers learn to recognize the various species in the field, since that is where they will be monitoring. Several field sessions in different settings should be scheduled. Earlier field sessions could include an aquatic plant expert guiding the group through identification. At later sessions, volunteers should complete the identifications either in groups or on their own. This type of training sequence provides enough repetition of information to allow volunteers to fully grasp the concepts and processes, while building their confidence in their abilities.

Data interpretation

Once your trained volunteers have begun collecting aquatic plant data, the amount of information that needs to be collected depends on your program needs. First, prior to training, you should determine what information is needed, and how accurate it needs to be. Second, the amount of data collected often depends upon the resources available for collecting the data. Frequently, intentions and ambitions exceed the time and materials available, so set realistic goals.

Concentrate your efforts on the most variable areas. They are the most difficult to describe. Do not base your sampling scheme on rare plants unless you are specifically looking for them. Rare plants are seldom sampled adequately.

Remember, often the majority of the cost or effort in sampling is fixed, so collecting extra samples costs little more. Think in round numbers to make life easier for data analysis. A couple of guidelines to help decide when you have enough data are species/area curves and running averages. When you are no longer finding any different species or much average change, you have probably collected enough samples.

Assessing plant community change usually requires some multiple sampling regime, generally at annual or longer intervals. Things to look for in determining change are maximum depth of plant growth, percentage vegetated littoral area, species diversity, relative percentage of submersed plants, relative percentage of sensitive submersed plants, total taxa, and presence of exotic species.

How much change between sampling periods is caused by seasonal and sampling variability and how much is real change? Some guidelines developed in

Wisconsin suggest that real change has occurred if the difference between two sampling periods is greater than: 0.8 meters in maximum growth depth; 13% in the proportion of open area in the littoral zone; 0.04 in Simpson's diversity or 4 in species number; and/or if floral or community similarity is less than 0.70. Values for your region may be different.

Summation

Aquatic plant monitoring can be a valuable project for volunteer programs. The information collected frequently represents the only information available for many locations. The key to developing a volunteer monitoring program is to determine what information is needed, and whether the resources are available to collect it.

Volunteers have successfully been trained to identify aquatic plant species with plant guides and keys, and have been particularly valuable for monitoring nuisance and exotic plants. Repetition is key to getting participants comfortable with aquatic plant identification. Combining classroom with field training provides a good environment and hands-on training opportunities.

For aquatic plant data to be most useful, monitoring needs to be done over time. Changes in plant communities provide information regarding both community health and water quality. However, some changes due to season or sampling regime are expected. Determining what changes are significant requires a fair amount of data, and reliance on statistical methods. Understanding and recognizing the limitations of volunteer plant monitoring is important in establishing a successful program.

Basics of Using School-Aged Monitors in Extracurricular Settings

Moderator: **Barb Horn,** Rivers of Colorado Water Watch Network
Speakers: **Steven Lee,** The Heritage Museum; **Mandy Richardson,** Maryland Save Our Streams; **Keith Wheeler,** Global Rivers Environmental Education Network (GREEN)

Steven Lee
The Heritage Museum of Art, 4509 Prospect Circle, Baltimore, MD 21216, 410/664-6711

The Gwynns Falls Wildlife Habitat Program

The Gwynns Falls Wildlife Habitat Program (GFWHP) is a model project in stream and wildlife conservation for urban areas. This is a program for the

revitalization and preservation of the indigenous natural resource that is the Gwynns Falls stream valley forest.

Originally land of the Seneca, the Gwynns Falls stream valley forest is a large wooded area of public and private lands bordered by a diverse array of neighborhoods. The park is made up primarily of Gwynns Falls and Leakin Park, together comprising over 1,200 acres. Features of the Gwynns Falls/Leakin Park include two streams, steep cliffs, open meadows, and a virgin forest. This is a unique and remarkable wilderness area, with wildlife communities seldom found in large urban settings. While some of the park's areas are frequently visited, other more isolated areas are rarely impacted by human contact.

Through the years of burgeoning city growth, this wilderness park has faced a barrage of threats: encroaching development, dumping, hunting, highways, and stream degradation. Through it all, many wild species, like the hawk, deer, and fox of our native area, have survived. But many of our native fish, waterfowl, and upland bird species have become critically endangered.

The health and future of urban communities are manifest in the quality, planning, and promise of the region's natural systems--streams, air, natural areas, and wildlife--that we barely notice, for all the concrete. However, the quality of the environment is just as crucial for cities as for rural areas. Unfortunately, the quality of many of our city environments has been deemed a lesser priority, sometimes to the point of their endangerment.

Using a comprehensive approach, the Gwynns Falls Wildlife Habitat Program was conceived to stimulate new cooperative thinking about human and wildlife communities in city planning. Based on the premise that the health of the city's forest is a prime indicator of the environmental health of the city, the GFWHP brought together governmental agencies, historical and environmental groups, community organizations, and schools in an interactive plan to preserve the native wildlife, plant species, and stream quality of the Gwynns Falls stream valley forest.

This project of the Heritage Arboretum (the environmental programs initiative of The Heritage Museum of Art) combined public park land, community organization-owned land, and individually owned land of neighbors into a partnership for wildlife habitat conservation. Each of these partners was critical, not just toward enabling a complete stream/ forest/periphery area, but also toward the evolution of a supportive spirit among all levels of the community.

The GFWHP, working in cooperation with the Maryland Department of Natural Resources, the Baltimore Department of Recreation and Parks, and neighbors, initially designated a fairly isolated 75-acre segment of the park area for wildlife habitat conservation. The area's primary characteristics include a stream with narrow riffles and wider calm sections, a linear island, meadows, rocky banks, a

steep cliff, and dense woodland slopes. The area serves as a frequent rest stop for many migratory birds, and as a homeland for several varieties of waterfowl and wetland species.

Youth initiatives

A prime directive of the GFWHP, from its inception, has been to provide initiatives that profoundly reestablish a bond with nature for inner city youths. Through the Service-Learning School Programs component, youth are offered sustained involvement and training in ecology and forest conservation, leading in turn to the cultivation of a new generation of enthusiasts for the future preservation of our city parks.

In microcosm, the construct of our schools initiatives reflects the interactive, cooperative approach of the GFWHP as a whole, again engaging various aspects of community toward the dual purpose of habitat conservation and youth education. Student involvement has been significant and integral, in both long- and short-term programs, for which students receive community service credits toward graduation.

Short-term programs are Special Projects in conservation. These are generally one-day events, such as tree and shrub plantings, stream cleanups, or conservation trail maintenance, where students from a number of schools work alongside other members of the community.

The GFWHP's main thrust for students are its long-term projects, currently the Bird Housing Program and the Biological Stream Monitoring Project. More highly structured than the Special Projects, these programs are developed in conjunction with classroom teachers, thus enabling them to incorporate ecological experiential learning into their curricula. The teachers are the key to the programs' continuity in their commitment toward long-range goals.

Each school project is also teamed with a professional environmental organization that serves as project leader and mentor to the students, particularly in field sessions. Through directed classroom and field studies, students achieve hands-on experience in the ecology of the watershed and its conservation. For instance, the GFWHP Bird Housing Program is developed in conjunction with the carpentry teacher of an area high school, and with the Baltimore Bird Club of the Maryland Ornithological Society as the class's mentoring organization. Carpentry students construct bird houses for several threatened species. On field trips, under the direction of the Baltimore Bird Club, the students install and monitor the houses in the wildlife conservation range. Lecture sessions with DNR forest rangers are also included in the field trips.

In conclusion, the Gwynns Falls Wildlife Habitat Program provides environmental interaction and training rarely made available to urban youths, who, in turn, help to preserve our wildlife communities of today and tomorrow.

Mandy Richardson
Maryland Save Our Streams, 258 Scotts Manor Dr., Glen Burnie, MD 21061, 410/969-0084, 800/448-582 or 410/969-0084

A Watershed Partnership

Project Heartbeat is a biological stream monitoring program developed for volunteers by Save Our Streams (SOS). The methodology is based on the U.S. Environmental Protection Agency's recommended Protocol II for rapid bioassessment, outlined in Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish (EPA-440-4-89-001). Project Heartbeat monitoring includes collecting macroinvertebrates using a kick-seine, performing a visual habitat assessment, and identifying the organisms to the family level in the lab. These are the same procedures that are used for the stream monitoring component of the Gwynns Falls Wildlife Habitat Program (GFWHP) of the Heritage Museum.

Student volunteers were solicited to work on the monitoring portion of the program through two interested science teachers at local Baltimore City Schools (Edmonson and Walbrook High Schools). Organizational meetings were set up between the teachers, Heritage Museum personnel, and Save Our Streams staff. Because this was the first year of the program, we decided to start with a small number of students--three from each school.

Participation in the program was offered to sophomores and juniors who excelled in sciences. The students were selected because they were responsible, interested in the project, and able to pass on the project to incoming students. The goal for the students was that they develop a sense of ownership and a desire to be responsible for the continuation of the project.

The monitoring year was planned during the organizational meetings. Specific dates were planned for stream monitoring events, laboratory identification training, and lab identification sessions. The stream monitoring portion of the GFWHP was scheduled for fall 1995 to fall 1996, with a monitoring session during each season, including winter.

The training event and first monitoring session were scheduled for the same day. The morning was an introduction to stream ecology, leading into an explanation of how and why streams are monitored. After lunch, we divided into three teams to collect samples.

We planned both events on the same day for two reasons. First, it was easier and more convenient. Second, we wanted the procedures to be fresh in the students' minds for the first monitoring event, thus ensuring greater confidence on the part of the students.

We also planned the first training to be more SOS-staff-intensive than any of the following sessions. Three SOS staffpersons acted as guides at each training site. The morning training session took place inside, away from the roaring stream, and where visual aids could be used. The students saw the monitoring procedures performed, though not in a realistic setting. Next, each staffperson was assigned to lead a monitoring team through its first actual collection. During subsequent seasons, the trainings were less SOS-staff-intensive. Instead, those trainings were refreshers, with teams composed of two to three students, a teacher, and sometimes a community volunteer.

After each collection activity, the students met back at the training site to compare samples and ask any remaining questions. This was a good time to reiterate concepts of stream ecology and watershed dynamics. For instance, you could initiate discussion by asking about insect diversity in the sample, and discussing why students did or did not find a good representation of different types of bugs. What are the possible pollution sources that could be affecting this particular stream? Teachers may also lead a reflection activity. For this project, students were asked to fill out an evaluation stating, "I liked....," "I did not like....," "I learned....," and "I wish I had learned...."

Laboratory identification of the insects is another facet of this project. Students were trained by a volunteer professional biologist to identify samples to the family level, thus giving students the opportunity to follow their sample from collection to identification. Save Our Streams' partnership with a local university, The University of Maryland Baltimore County, helped secure a facility for laboratory identification. SOS regularly utilizes the university's labs for these purposes. The GFWHP has discussed moving lab sessions from the university into the high schools where students attend classes.

As in all programs, some things worked well, while others needed improvement over the course of the project. One of the challenges has been to get the same students to attend each monitoring event and lab session. Due to schedule conflicts and other unforeseen circumstances, there were often as many new students as experienced students at an event. Such a problem challenges the continuity of the project. Another challenge has been to relate the monitoring to the students' neighborhood streams. Although we are monitoring in their watersheds, many times the students do not get to see the lower-order streams that run underground or through channels in their parts of the city. A bus tour of the Gwynns Falls watershed or similar activity with accompanying maps would help the students understand exactly how they relate to the Gwynns Falls Wildlife Habitat Program.

In conclusion, there are many benefits to using student volunteers as stream monitors. Students are enthusiastic and bring a great deal of creativity to the monitoring process. They are also the stewards of today and tomorrow, and for that reason, it is necessary that they be incorporated in the national volunteer monitoring effort.

Keith Wheeler
Global Rivers Environmental Education Network (GREEN), 206 S. Fifth Ave., Suite 150, Ann Arbor, MI 48104, 313/761-8142, green@green.org, Web site http://www.earthforce.org/section/programs/green/

Environmental Monitoring and Education in Non-Formal and Informal Settings

The Global Rivers Environmental Education Network has developed an educational model for watershed sustainability that works to weaken the barriers between formal, non-formal, and informal education. GREEN's model focuses on the premise that **education is lifelong,** and that if one is going to educate with **empowerment, change,** and **action** as the major outcomes, then having convergent strategies that address the same or similar audience is key if we are going to achieve our vision. Our focus is that watershed education needs to be community based, i.e., a learning community. This means that schools, civic organizations, businesses, governments, youth groups, senior groups, etc., all need to be involved and that this involvement needs to be integrated, with integrated learning outcomes.

Monitoring for the sake of monitoring is a meaningless exercise! Monitoring with youth or adults must be put into context, at both a personal and a community level. Some key components to all education programs that have monitoring as one of their elements include:

- Creating a vision with all stakeholders--youth, leaders, outside community members, etc.
- Defining goals and creating the necessary elements to achieve those goals (training, communication strategies, partnerships, mentoring opportunities, etc.).
- Maintaining community partnerships (for funding, technical expertise, local communication, and greater public awareness).
- Linkage of outcomes in the non-formal or informal setting to learning opportunities in formal settings. Empowerment in youth needs reinforcement from as many avenues as possible. Educational research has shown that if youth are empowered before age 15, they will become empowered, action-taking adults. But if they do not have this critical learning experience, then the probability of their becoming involved adults diminishes significantly.

GREEN has assisted in developing over 25,000 water-focused learning communities worldwide. Each community has a different initial entry point, such as through a school-based program, a youth group, a business organization, a governmental organization, a religious group, etc. The endpoint in mind is our evolving to the point where all of these groups are working together as communities of learners, whose goal is watershed sustainability.

In the non-formal and informal areas, GREEN has many case studies in which our work with international religious organizations, international youth groups, scouting organizations, World Wide Web-based distance learning initiatives, and media-based initiatives has led to monitoring activities.

Designing Effective Adult Training

Workshop Leader: **Meg Kerr,** University of Rhode Island Coastal Resources Center

Meg Kerr
University of Rhode Island Coastal Resources Center, S. Ferry Rd., Narragansett, RI 02882, 401/874-6522 Designing and Delivering Effective Adult Training

Training is an essential component of any volunteer monitoring project, yet volunteer training is rarely given the time and attention that it deserves. Program coordinators wear many hats and work hard to hone their skills as environmental scientists, media specialists, community organizers, and data analysts. Equal attention should be paid to working on training skills.

When we train volunteers, we achieve many objectives. Our primary objective is to teach volunteers the scientifically correct way to perform monitoring tasks. During the training, volunteers learn the ecological concepts behind the monitoring tasks. They are given the tools and information they need to "do the job right" and to explain their activities to their family and friends. Good training is the first component of a monitoring program's quality assurance process. Training sessions also build essential connections between program volunteers and the program staff. Training sessions are important social events, providing volunteers with an opportunity to meet staff and other volunteers in the program. For many volunteers, training sessions are an important reward for participating in the program.

Good training takes planning, and this paper discusses four critical steps for designing effective adult training. The first step is delineating a target audience. For monitoring programs, the audience is our volunteers, but we need to understand who they are and what their needs are as adult learners. The next step is to write clear, measurable, and reasonable training objectives that acknowledge constraints on time and staff. Third, the training session is designed, and finally, in step four, it is evaluated.

Step one: Understanding adults as learners

Professional educators understand that there are certain ways that children learn, and classroom curricula are designed with these concepts in mind. Similarly, a good volunteer monitor trainer needs to appreciate the learning process for adults and design training programs to take advantage of these characteristics.

Four pertinent characteristics of adult learners are listed below. Accompanying each characteristic are suggested ways to address adult learning during the training process.

12. Adults are mature and need to control their learning. Traditional classroom learning gives the teacher the power while the student is passive. Adult training should allow the students to have a key role in directing the learning process.
    - When beginning a training session, present your training objectives and session agenda to the volunteers. Give them an opportunity to discuss and adjust the plan for the day.
    - Get to know your volunteers before or during the training. Find out why they are participating in the monitoring program and try to design their "job" to satisfy their interests.
13. Adult learning requires a climate that is collaborative, respectful, mutual, and informal. Adults bring a vast personal experience to the learning process. It is essential that the trainer recognize and use this experience.
    - Minimize lectures. Studies have shown that learning retention is increased when we become actively involved in the learning process. For example, it has been found that over a period of three days, adults remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say and write, and 90% of what they say as they do. Monitoring training sessions should be paced to allow time for volunteers to hear about the monitoring program, perform the monitoring techniques themselves, and then reflect on the learning by asking and answering questions.
    - Provide opportunities for group work. Use your experienced volunteers to mentor newer volunteers. Reinforce your instruction by designing problem-solving exercises for groups to work on. Design role plays to reinforce the learning. Traditional classroom teaching assumes that students learn well by listening, reading, and writing. In reality, people have a variety of learning styles. Some people learn best through logic and problem solving, some through pictures, charts, and maps. Some people work best on their own and others work best in groups. Learning styles are very individualized, and group exercises can be designed to provide a variety of learning environments.

- Encourage volunteers to share experiences and expertise. Provide volunteers with additional learning materials.

14. Adults need to test their learning as they go along, rather than receive background theory and general information. Adults need clear connections between content and application so they can anticipate how they will use their learning.
    - Start your training session with kits and techniques, and save the lecture on ecology for later. Use the car salesman technique--take it for a ride, then supply the details.
    - During the training, work with your volunteers to devise an action plan for using their data. With whom will they share their data? What do they think needs to be done to improve the water body? How will the monitoring help them achieve these goals?
    - Provide time in the training to discuss how the volunteers will use their new knowledge. Remember that volunteers are in the field and are often asked questions about what they are doing and why. Use role-playing to build their confidence so they can educate their communities about the resources they are monitoring.
    - Use volunteers as trainers. Provide other opportunities for volunteers to take on new challenges.
15. Adults need to expect performance improvements to result from their learning. Adult learning needs to be clearly focused in the present and be "problem centered" rather than "subject centered."
    - Help volunteers evaluate your training and their own performance.
    - Train volunteers in groups. Encourage them to set goals for themselves and then mentor each other to achieve those goals.

Step two: Preparing training objectives

Before beginning a training program, carefully consider what you are trying to teach. Monitoring programs focus on skills. It is essential that volunteers learn how to perform monitoring tasks with skill and accuracy. But we are often interested in teaching more than just skills. We want to enhance volunteers' knowledge of safety, scientific methods, and basic ecological concepts. We may want them to comprehend the importance of nonpoint source pollution and understand the relationship between water quality and personal actions such as fertilizer application. We may want them to be able to trouble-shoot equipment problems, or analyze results collected during their monitoring. Identify what you are trying to teach, then design a training program that moves from the simple topics to the more complex.

Training should be designed to achieve training objectives. A training objective is a brief, clear statement of what the participant should be able to do as a result of the training. Usually, a training objective includes three parts:

16. A statement of the participants' terminal behavior. Try to write this with an action verb so you can design ways to evaluate your success. If you are teaching ideas, think about what you want the participants to be able to DO with the ideas. Examples could be: "Participants will be able to analyze the dissolved oxygen content of river water"; "Participants will be able to list home lawn care best management practices (BMPs)."
17. A statement of the standards that the trainee is expected to attain. Include information on quantity and quality, and make the standard time-bounded. For example, "Trainees will analyze two dissolved oxygen replicates, obtaining results that are within 0.6 mg/l of the known value in 30 minutes"; or, "Trainees will list four of the BMPs that are among the 10 most effective methods for controlling NPS pollution from home lawns in 20 minutes."
18. A statement of the conditions under which the trainee is expected to perform--for example, "in the field with a LaMotte kit."

For monitoring skills, it is often necessary to conduct a task analysis before writing training objectives. A task analysis is a sequential listing of all the steps necessary to perform a task. Monitoring manuals often contain task analyses. A task analysis provides the logical sequence of all the steps needed to perform a monitoring job and also identifies potential problems that could occur. The task analysis can be used to identify prerequisite skills and knowledge.

Once the monitoring tasks have been analyzed, training objectives are written to identify the steps that are to be learned and the standards and conditions under which they are to be performed.

Step three: Designing a training session
Planning a skill session Skill

training takes time. Monitoring trainers frequently try to teach too much in too little time, and do not give volunteers the opportunity to adequately understand unfamiliar techniques. A carefully planned skill session has three parts:

Introduction. This should be a short introduction to the skill, not an introduction to the monitoring program or to ecological concepts.

Body. The body of the skill session should include four sections:

- Show: The skill should be demonstrated to the volunteers. The demonstration should accomplish the learning objective you have written for the volunteers.
- Show and tell: Repeat the demonstration a second time, explaining the technique as you proceed. It is not important to accomplish the learning objective this time. This demonstration is shown slowly, step by step, allowing the volunteers to follow along with their own equipment.

- Check of understanding: Ask volunteers to review the steps and the points you have emphasized.
- Practice: Provide volunteers with adequate time to practice. Give them a task analysis to follow and adequate materials to work with.

Conclusion. Review the steps and key points. Answer the volunteers' questions. Find out what steps they found difficult, and critique your task analysis.

Training sessions should provide a full skill session for each technique that is being taught.

Coordinating the training program

Planning a training session requires attention to detail. The following list provides a reminder of things to check as you plan and conduct the training.

Before the training:

23. Communicate with volunteers. Give them the time, place, and duration of the training. Send directions. Tell them what to bring (pen, paper, lunch), how to dress, what to do in case of rain. Provide them with the name and phone number of someone to contact with questions about the training. Outline the training content and provide them with pre-training readings.
24. Arrange guest speakers. Provide them with the same information you are providing the volunteers attending the training.
25. Prepare materials (sampling kits, manuals, data sheets, overheads, slides, food).

    During the training:

26. Arrive early to set up and prepare. Volunteers will often arrive early, and you want to be there to greet them.
27. During the first hour:
    - Introduce yourself to each volunteer as they arrive.
    - Introduce volunteers to each other.
    - Try to have a key person in your organization open the program.
    - Cover basic administration.
28. Ask volunteers to jot down personal objectives for the training and for participation in your program. Take time to listen to these and, when possible, adapt the training plan to achieve volunteers' objectives.
29. With guest speakers:
    - Make sure they are still available immediately before the date of their presentation.
    - Introduce them personally.
    - Don't leave the training room during their remarks. They may need your assistance.

- Make sure all handouts are ready.

30. Organize regular reviews and tests of learning.
31. When closing a program:
    - Review objectives and ask volunteers if those objectives have been met.
    - Briefly review each major session.
    - Ask volunteers to complete an evaluation.
    - Thank volunteers for attendance and interest.

    After the training:
    Take care of administrative details:

    - Clean up the training room and return materials.
    - Store all handouts and materials. Retain a master copy.
    - Pay bills.
    - Write thank-you letters.
32. Note and file suggestions for improvement.

Step four: Evaluating a training program

Evaluation is an essential part of any training program, and it is a key part of training for volunteer monitors. Evaluations allow trainers to assess whether they have met their training objectives. For training designed to teach monitoring techniques, evaluations are conducted to assess the competency of the volunteers. Coordinators need to be sure that volunteers can collect data that meets the data requirements established by the program.

Evaluations also allow trainers to assess the strengths and weaknesses of their training programs. Good trainers are always revising and improving their training sessions in response to participant feedback.

Trainers should consider three types of evaluation: within-training evaluations, terminal evaluations, and post-training evaluations.

Within-training evaluations:

Evaluations of volunteers' ability to conduct each monitoring test should be conducted during the training session. Trainers should not move ahead to a new concept or method until they know that all the participants understand the material already covered. If one or two volunteers are having difficulty with a method, the trainer can make arrangements for mentoring or tutoring after the training is completed.

Terminal evaluations:

Every training session should conclude with an evaluation of the participants' learning and the trainer's teaching. Written surveys are often used for these evaluations, but trainers can enhance the written survey by leaving time at the end of the training for discussion.

Post-training evaluations:

Monitoring coordinators cannot assume that information learned at the end of a training session will be retained by the volunteers for a long time. Most of our adult volunteers are busy with other activities and may forget or become confused about information presented at the training. Quality assurance plans should include provisions for periodic evaluation and retraining of volunteers. These sessions are often conducted one-on-one, in the field at the monitor's sampling site.

Coordinated group discussions or focus groups can be used to evaluate the long-term effectiveness of non-technical volunteer training. These sessions can also be structured to provide useful feedback on the scope and goals of the monitoring program.

Water on the World Wide Web

Workshop Leader: **Ken Cooke,** Kentucky Water Watch

Ken Cooke
Kentucky Water Watch, Kentucky Division of Water, 14 Reilly Rd., Frankfort, KY 40601, 800/928-0045

This session was conducted as a hands-on tour of the Inter net, using the facilities at a University of Wisconsin computer lab. Participants navigated through a tour designed by workshop leader Ken Cooke, which took them to a variety of water-related sites on the World Wide Web.

To view the tour, visit Web site:
http://www.state.ky.us/nrepc/water/conf/wkswater.htm

For a report on the national conference itself, visit the main conference site at:
http://www.state.ky.us/nrepc/water/conf/vols.htm

CONCURRENT SESSION 2

Incorporating Stewardship in Your Monitoring Program

Workshop Leader: **Joan Kimball,** Massachusetts Riverways Program

Joan Kimball

Massachusetts Riverways Program, Department of Fisheries, Wildlife & Environmental Law Enforcement, 100 Cambridge Street, Room 1901, Boston, MA 02202, 617/727-1614, ext. 384

Note: This session was conducted as an interactive workshop. Following is a summary of the discussion.

My objective for this workshop was to involve all the participants in an interactive discussion of stewardship and volunteer monitoring. I have attended many conferences where the "audience" knows as much as, or more than, the workshop presenters, yet there are few opportunities for people to share their knowledge. The longer I give workshops and training sessions in Massachusetts, the more I appreciate the interactive approach. However, as a facilitator, I find it a challenge to design an interactive workshop that meets the needs of all the participants and allows for interaction and sharing of experiences and insights. The facilitator must be creative in planning for each workshop, considering both the purpose of the meeting and the interests and skills of the participants. I believe that workshops are always better when participants share their thoughts and experiences. The sum of this group knowledge is greater than the individual parts. I always learn a great deal in an interactive workshop.

The goals of this workshop were, as a group, to (1) define stewardship, (2) discuss the barriers that prevent stewardship from being the objective of water quality monitoring programs, (3) find ways to help existing groups incorporate stewardship into their work, (4) present a model that incorporates stewardship from the beginning, and (5) suggest strategies for new groups.

Defining stewardship

First, we broke into small groups to discuss the concept of stewardship. After coming back together as a larger group, we created the following definition of stewardship:

> *Stewardship is a long-term commitment to a river, wetland, or other natural resource. Stewards--those who serve to protect and restore rivers, ponds, and wetlands--speak on behalf of a resource that cannot speak for itself.*

We also developed a list of characteristics of stewards and stewardship:

- Based on historical context, stewards look to the future when they work on behalf of the resource.
- Stewardship is based on knowledge about the resource and what the resource requires to be healthy.
- Stewards learn skills and strategies that encourage involvement from a broad base to achieve protection for the resource.
- Stewardship includes advocacy. Advocacy may include confrontation, but it may also be non-confrontational and educational.

Barriers to stewardship

In answer to the question of why some monitoring organizations are unable to move from data collection to stewardship, we came up with a number of barriers. A lack of vision and/or a lack of mission can make it difficult for groups starting a project to look at outcomes that lead toward protection of a river, pond, or wetland. If people involved only want to "do the science," it can be hard to move toward stewardship. Often groups lack the knowledge of how to be advocates for a water resource. Fears of political repercussion (for example, a teacher who fears losing his/her job if students raise questions that challenge important people), of stirring up controversy, of seeming radical, of being criticized, of turning people off, or of scaring away funding can be additional obstacles to stewardship. On the other hand, many groups report that taking appropriate action brings in active members and creates respect. Also, a proven track record facilitates future funding.

Incorporating stewardship for an existing monitoring group

Using an example, we considered how an existing water quality monitoring group can change its focus and incorporate stewardship. The example we used was this: Two years ago, a group of ten people decided to begin a monitoring program. They chose easily accessible sites. Recently, the group found high fecal coliform at two of the sites. They made several calls to officials at the state level, but nothing happened.

Based on this example, workshop participants made several recommendations designed to help monitors in an existing monitoring group incorporate stewardship in their program.

The first step is for the water quality monitors to realize that no one else will fix the problem (in this case high fecal coliform) if they themselves do not get involved. A second step is to identify the sources of the problem and to look at possible solutions (the group may want to bring in experts). The monitoring group should use the problem as an opportunity to revitalize the group by reconnecting with the original purpose of forming the group and connecting the monitoring work more closely with the resource. The monitoring group may also wish to broaden its base and involve other groups including abutters, civic organizations, town officials, canoeists, anglers, colleges, and schools. Workshop participants suggested that the monitoring program start an "Adopt-A-Stream" group in order to strengthen the monitoring program. Strategies discussed included

holding workshops, bringing in individuals with people/leadership skills, and learning how to arrive at consensus.

We discussed ways to use the high fecal coliform levels as an opportunity to involve and mobilize the community by publicizing the problem and making it relevant. It is important to tell the story in a way that engages officials, community, and media, and to share with the public what will happen if nothing is done to correct the problem. Strategies include holding a press conference with allied organizations or partners.

As the monitoring group works on solving the problem, it should stick to facts (not personalities), do the necessary homework, consider bringing in experts to overcome obstacles, conduct additional monitoring to further define the issues, redesign the monitoring program if necessary, leave a paper trail, and bring in allies (for example, collaborate with other resource users such as canoeists, anglers, abutters, etc.).

Stewardship model: Massachusetts

In Massachusetts, the Riverways/Adopt-A-Stream Program works with groups to create Stream Teams that provide stewardship for rivers and streams. We have found that "Shoreline Surveys" (visual surveys) are an effective tool to help groups focus on stewardship. Drawing on a broad base of community people (anglers, canoeists, river landowners, business persons, and local officials), Stream Teams have worked to protect or restore water quality, adequate flow, habitat, and land adjacent to rivers. Massachusetts Stream Teams use Shoreline Surveys to (1) build a strong constituency for the river, (2) generate baseline data from field observation, (3) determine priorities for protection, (4) create community consensus on an action plan for the river, and (5) assist local citizens, municipal governments, businesses, civic organizations, and state agencies to work together to achieve successes in river protection.

The Massachusetts Riverways Program holds a training session for each group. Using an interactive slide show, facilitators go over each of the data questions. By essentially doing a Shoreline Survey in the room, participants gain a shared view of what a river needs to be healthy. The Stream Team determines the purposes of their survey. Each group is different, but the goals can include developing baseline data, determining water quality monitoring sites, creating a constituency for the river, agreeing on an action plan, and implementing the plan.

Using data sheets, cameras, and maps, people go out on the river to look for problems (such as evidence of nonpoint source pollution, pipes discharging in dry weather, erosion) and assets (important habitat, land that might be protected, potential trails, canoe and fishing access points). Once these lists have been compiled, the Stream Team determines their priorities for action. At a subsequent meeting, the group reviews each of the priorities and comes to consensus on an action plan. Then the group begins to take action, based on the plan.

Because surveyors include landowners, business persons, and municipal officials, as well as other people who use the river (e.g., canoeists, anglers, hikers, and naturalists), the Shoreline Survey process is educational and cooperative.

After learning in general what rivers need to be healthy, and in particular about conditions on their river, group members work together on solutions and avoid the pitfall of finger pointing. Because town officials are brought in during the planning stages, they will be allies in helping to find solutions when problems are found. There are many benefits in using this approach. The river gains additional protection, businesses feel more connected to the community, town officials feel satisfaction when constituents understand their work, constituents understand how they can work effectively with others, and landowners can learn better ways to manage their lands to protect rivers. We have found that following this process leads people to bond to each other and to the river. From the first stages, stewardship is the goal of the Stream Team.

Stewardship suggestions for new groups

The last group exercise we did involved identifying issues to consider when designing a new program. When you begin, consider whom to invite to join your group. Include a broad base from your community. Think about inviting people with a range of skills including leadership skills, people skills, technical skills, writing skills, and telephoning skills. Groups may want to organize around the shoreline survey process, in which you develop a common understanding about what the river needs to be healthy and participants create a plan to improve the river. At a preliminary meeting, do a visioning exercise in which people think about what the river could be like in 20 years in the best-of-all-worlds. Seek the perspectives of a broad base of people, including old-timers, anglers, and landowners. Always connect individuals directly to the resource. Don't always be adversarial. Use different strategies for different problems. If you are in a contentious situation, you may want to get a facilitator to help find common ground for working through problems.

If you decide to set up a water quality monitoring program, determine your mission before you start and make sure stewardship is the focus. Set achievable goals and make sure your monitoring is aimed at solutions. Take time to design your monitoring program so that your monitoring is credible. Utilize data effectively, and know how and where to get help when you need it.

Make sure that volunteers are adequately trained and receive positive feedback. Set priorities when taking action by examining choices and using consensus to determine which choices will be most effective. Use active listening skills and assign tasks to people who have appropriate interests and skills. Take credit and give credit where it is due. Celebrate successes, be positive, and always have fun!

Using Monitoring to Set Restoration Goals and Evaluate Success

Moderator: **Karen Firehock,** Izaak Walton League of America
Speakers: **Tamara McCandless,*** U.S. Fish and Wildlife Service; **Geoff Dates,** River Watch Network

Geoff Dates River Watch Network, 153 State Street, Montpelier, VT 05602, 802/223-8080

Measuring Success: Monitoring the Effectiveness of Agricultural Management Practices in Restoring Stream Biota

Project description

Morris Brook is a small stream that flows through the Rocky Hill Farm, an active dairy farm owned and operated by Dale Lewis in Haverhill, NH. Beginning in 1991, Agricultural Best Management Practices (ABMPs) were implemented on this farm to reduce contamination of Morris Brook by sediment, cow manure, and fertilizers. Beginning in 1992, volunteers and staff of the Connecticut River Watch Program (CRWP) and River Watch Network monitored water and benthic macroinvertebrates (bottom-dwelling organisms such as aquatic insect larvae) to determine the impacts of the farm on Morris Brook and to see if the impacts were reduced over time as the ABMPs were put into place.

The agricultural waste management efforts included a number of measures: (1) construction of manure storage areas to allow careful timing of the application of manure to assure nutrient uptake by crops and avoid contaminating the brook, (2) construction of concrete pads in heavy-use areas to minimize soil disturbance, (3) guiding house and barn roof runoff away from heavy-use areas, and (4) animal management, including the construction of a stream crossing to keep the animals out of the stream as they are going to and from the pasture. The stream monitoring included three types of assessments from 1992 to 1994:

1. **Water sampling and analysis** for E. coli bacteria, total phosphorus, and turbidity. Water samples were collected in presterilized bags and analyzed within six hours at a project lab using "Standard Methods."1 Samples were collected at six locations above and below the main farm activity area (see map on page 23) five to seven times per year from June through October. Results for the sites below the farm were compared with the sites above the farm and with the water quality criteria in the NH Water Quality Standards.
2. **Benthic macroinvertebrate sampling and analysis** using a standard metal frame net and a rigorous collection of three samples2 at each of three sites (MoB017, MoB010, and MoB001--see map). Samples of bottom-dwelling organisms were collected once per year in mid-October. Samples were preserved in alcohol and the organisms identified to the family level for aquatic insects, and to higher taxonomic levels for mollusks and worms. From these results, various measures of the abundance, composition, pollution tolerance, and diversity of the

community were calculated. Results for the sites below the farm were compared with the site above the farm over the three-year period.

3. **Benthic macroinvertebrate habitat assessment** using visual estimates and measurements of stream characteristics that determine the quality of the habitat, such as the composition of the river bottom, the current velocity, the extent to which the bottom was embedded with sediment, and other factors. The assessment was done at the benthic macroinvertebrate collection sites. The results were used to determine the extent to which the benthic macroinvertebrate community is affected by habitat conditions versus water quality and to assess changes in habitat conditions caused by the farm.

[1] *"Standard Methods" is short for Standard Methods for the Examination of Water and Wastewater, a standard laboratory reference manual produced by the American Public Health Association.*

[2] *Each sample was a composite of four collections in fast and slow current.*

Summary of results

In summary, the benthic macroinvertebrate community of the brook downstream of the farm has improved, but a bacteria contamination problem remains. It's interesting to note that if this assessment had relied solely on water sampling, we might have concluded that no improvement in the brook had resulted from implementation of agricultural best management practices and expenditure of public funds. On the other hand, had water sampling not been carried out, the bacterial contamination problem would have been missed. Clearly, there is a benefit to using both approaches in assessing the effectiveness of pollution control projects. Specifically, we found that:

1. **Water sampling and analysis showed elevated bacteria levels in Morris Brook at all sites throughout the sampling period.** Sixty-eight of the 88 samples collected exceeded the bacteria criterion (406 colonies per 100 mL) in the NH Water Quality Standards. While this is reflected mostly at the impact sites, it was also true in 28 out of 43 samples at the three reference sites (MoB017, MoB016, MoB015). This pattern was consistent under wet and dry conditions despite the installation of agricultural best management practices. This suggests that the bacteria problem is not runoff-related, but comes from a relatively constant source, such as defecation by farm animals directly into the brook, or a failing septic system.
2. **Water sampling for total phosphorus and turbidity showed somewhat elevated levels below the farm most of the time.** Total phosphorus levels were occasionally very high, but not necessarily in connection with wet weather. Turbidity was usually low, with slightly higher levels below the farm. Neither indicator appears to be a significant problem at this time.
3. **The brook's benthic macroinvertebrate community showed significant improvement over the three years at the sites downstream of the farm.** The community at the downstream sites became more like that at the reference site, with greater diversity and fewer pollution-tolerant organisms. In 1993, the impact

site (MoB010) was in the moderately impaired category, while the recovery site (MoB001) was at the better end of the range of the "moderately impaired" category. By 1994, both sites fell into the "non-impaired" category. This suggests that the agricultural best management practices implemented on the farm reduced organic pollution and improved the quality of the brook's ecological integrity, despite consistently elevated bacteria levels. The two graphs on page 23 illustrate the percent similarity between the communities collected at the two downstream sites (MoB010 and MoB001) and the reference site (MoB017) upstream of the farm.

Conclusions

The following conclusions all point to the need for routine monitoring of the benthic macroinvertebrate community as part of the assessment of the effectiveness of agricultural best management practices. The conclusions also illustrate the importance of careful project and site selection.

1. **The Rocky Hill Farm appears to be causing elevated bacteria levels in Morris Brook. These levels did not change significantly over the three-year period.** In general, the water sampling and analysis showed elevated bacteria levels in Morris Brook at the impact sites below the farm throughout the sampling period. This pattern was consistent despite the installation of agricultural best management practices. Especially puzzling is that bacteria levels were high during dry weather sampling. The site with the lowest three-year geometric mean was the recovery site.

   The agricultural best management practices on the Rocky Hill Farm were designed to reduce sediment, manure, and nutrients carried into the brook during runoff events. Bacteria carried into the brook during the relatively few runoff events would not be expected to survive for days, and even if they did, they would be carried downstream into Oliverian Brook within a few hours. It's very unlikely that our dry weather sampling would have picked them up. This suggests that the bacteria problem is not runoff-related, but from a relatively constant source. Possibilities include defecation directly into the brook by farm animals, or a failing septic system.

2. **The agricultural best management practices appear to have improved the benthic macroinvertebrate community in Morris Brook over the three year period.** The brook's benthic macroinvertebrate community showed significant improvement over the three years at the impact and recovery sites. Diversity and representation of organic pollution-intolerant organisms increased. The community at these sites became more like that at the reference site. This was particularly true at the recovery site (MoB001), which improved dramatically over the three years. This suggests that the agricultural best management practices implemented on the farm reduced organic pollution and improved the quality of the brook's ecological integrity, despite consistently elevated bacteria levels.

Conditions at the reference site in 1992 were not optimal but did improve over the study period. Bacteria results suggest that even this upstream site receives fecal contamination. Yet, it's unclear why the benthic community at this site improved since bacteria results did not improve over the three-year period. The change in sampling method could be a partial explanation. Since more organisms and more representative samples were collected in 1993, a better mix may have been collected.

Conditions at the recovery site improved over the study period. This improvement was likely due to the implementation of ABMPs, since all other conditions on the farm were the same. The improvement from 1992 to 1993 could be due, in part, to the improved collection method. But the improvement that occurred during the next year suggests that this is not the sole explanation. In summary, the benthic macroinvertebrate community of the brook downstream of the farm has improved, but a bacteria contamination problem remains.

3. **Water monitoring and benthic macroinvertebrate monitoring are both important in assessing the effectiveness of pollution control projects.** It's interesting to note that if this assessment had relied solely on water sampling, we might have concluded that no improvement in the brook had resulted from implementation of agricultural best management practices and expenditure of public funds. On the other hand, had water sampling not been carried out, the bacteria contamination problem would have been missed. Clearly, there is a need to use both approaches, when possible, in assessing the effectiveness of pollution control projects.
4. **A good demonstration site is essential.** We also note that the Grafton County Conservation District chose a good demonstration site--a dairy farm on a small stream with no other apparent pollution sources. The small size of Morris Brook clearly shows impacts. A larger stream might not have shown impacts the same way, since more water would have diluted contamination. Further, small brooks tend to contain macroinvertebrate communities that are naturally less tolerant to organic pollution than larger streams, because they are naturally less productive. Therefore, these communities tend to be more sensitive to changes.

   The presence of riffle habitats in the right locations above and downstream of the farm was also fortunate. These factors made it possible to isolate and demonstrate impacts from the farm.

5. **Family-level identification of benthic macroinvertebrates is essential.** Family level identification of the benthic macroinvertebrates was essent ial because several critical metrics--precise family-level richness, pollution tolerance, dominant families, functional feeding groups, and community similarity--could not have been calculated from major group/order-level data. These metrics were essential to analyzing the results.

Reference:

Dates, Geoff. 1995. *The Impact of Agricultural Best Management Practices on Morris Brook; 1992-1994 Monitoring Report.* River Watch Network, Montpelier, VT.

Creating Watershed Monitoring Networks

Moderator: **Mike Rigney,** San Francisco Estuary Institute
Panelists: **Mike Rigney,*** San Francisco Estuary Institute; **Todd Running,*** Houston-Galveston Area Council; **Anne Lyon,** Tennessee Valley Authority

Anne E. Lyon
Tennessee Valley Authority-Clean Water Initiative, 1101 Market St., CST 17D, Chattanooga, TN 37402-2801; 423/751-8547; alyon@tva.gov

The TVA Clean Water Initiative Networking Experience

The Tennessee Valley Authority (TVA), in an effort to address water quality issues on a local level, formed the Clean Water Initiative (CWI) in 1993 to identify the root causes of water resource problems and bring together the people and organizations necessary to fix them. Besides assessing conditions, CWI's River Action Teams (RATs) work involves forming partnerships, watershed committees, citizen monitoring networks, and school-based volunteer monitoring/education programs, and initiating best management practices (BMP) demonstrations, habitat restoration projects, stream bank stabilization projects, storm drain stenciling programs, and shoreline cleanups. CWI RATs work with communities to provide the services, skills, and expertise groups need to get started, implement and fund projects, and become independent.

Since CWI's inception 4 years ago, RATs have become involved in starting or participating in the development of a variety of unique water monitoring/restoration networks. They include the Middle Fork Holston Watershed Committee's Adopt-A-Watershed project, the Second Creek Task Force/AmeriCorps Partnership, the Chattanooga Summer Volunteer Monitoring Program, the Trout Unlimited Volunteer Sediment Monitoring and Trout Stream Restoration Project, and the Friends of the North Chickamauga Creek Greenway School-based Acid Mine Draining Monitoring Project. The following is a brief description of how and why the groups formed, how they are organized, and what they achieved. TVA initiated most of these networks to meet a CWI goal, but they have continued or evolved to address additional issues because of community needs and support for the programs.

Middle Fork Holston Watershed Committee's Adopt-A-Watershed Program

Taste and odor problems were plaguing the water supply in Marion County, Virginia. In 1986, the Middle Fork Holston Water Quality Committee formed and determined that poorly managed livestock operations were responsible for 90% of the problems. Within 5

years, the committee worked with farmers to install 48 BMPs on 15 farms. The remaining challenge was to get reluctant farmers to buy in, so in 1993 the committee decided to start an Adopt-A-Watershed program. After consulting with local schools, they decided to: (1) turn the program into a teacher enrichment/ development activity and give teachers new tools to make teaching required subjects more exciting; (2) provide teachers access to resource professionals who would work with them and their classes; (3) provide a 40-hour summer teacher training course to train teachers in every aspect of the program and give them experience using classroom instructional activities; (4) provide 3 hours of college credit which could be applied toward teacher recertification requirements; (5) provide the school with equipment and other resources that become school property; and (6) reward the school for completing a BMP project (using a Monsanto grant which would provide $100 per water quality improvement project completed to the school or school club they chose). They decided to pair agency professionals with teachers and form "watershed teams" to adopt small watersheds near their schools. Teachers and students work in their teams to conduct watershed surveys, create primitive GIS overlay maps of land use/land cover/pollution problems, develop and implement monitoring plans, pinpoint water quality problems, and develop plans to install BMPs. Since VA Adopt-A-Watershed formally began in 1995, they have secured an EPA Environmental Justice Grant which funded a full-time coordinator for the program, and the Holston RAT has taken a supporting role. The Holston RAT is currently working with the California Adopt-a-Watershed program to adapt their more urban-focused program for use in the tri-cities area of northeast Tennessee.

Second Creek Task Force/AmeriCorps Partnership

Ijams Nature Center was instrumental in developing the Knoxville Annual River Rescue and in 1992, they convinced the City of Knoxville (Mayor, Planning Commission, Parks and Recreation Department, Stormwater Management Division), the Knoxville Utilities Board (KUB), TVA, the University of Tennessee, and other environmental groups to form the Knoxville Water Quality Forum (WQF) to evaluate the condition of urban creeks and to focus the attention and resources needed to clean them up. The group decided to start with one creek--Second Creek, which was in extremely poor condition with fecal coliform counts of over 30,000! In 1993, the Second Creek Task Force (SCTF) formed as a committee of the WQF. Within the first year, SCTF members identified a broken sewer line, which KUB replaced, and held a small cleanup. In 1994, the Fort Loudon/Watts Bar/ Melton Hill RAT worked with the SCTF to organize and conduct Community Stream Walks from the headwaters to the mouth, using EPA Region 10's Stream Walk program to document baseline conditions and identify water quality issues. In 1995 the President's AmeriCorps program was formed and the city decided to apply for AmeriCorps volunteers. KUB, the city, and TVA agreed to fund four positions to form an AmeriCorps Water Quality Team (AWQT) to work with the task force. The AWQT helped (1) organize community groups to attend "Recons" with CWI biologists to evaluate the fish and benthic community at selected sites; (2) stabilize a steep eroding bank by planting over 500 trees; and (3) organize several stream cleanups and a community Second Creek Water Festival at a playing field located on the creek. A technical committee of the SCTF developed a water monitoring program and KUB

supplied the necessary supplies (HACH spectrophotometer, HACH turbidimeter, YSI multi-probe, and sterile containers/coolers to collect and transport fecal samples to KUB labs for processing). AWQT conducted the weekly (summer) and monthly (winter) sampling, and their data helped pinpoint problems. In 1996, the SCTF really took off when they obtained a multi-year 319 grant; currently, plans are under way to install a number of BMPs.

Chattanooga Summer
Volunteer Monitoring Program

The Chickamauga/Nickajack RAT decided to expand the team's fecal monitoring program at swimming beaches along Chickamauga and Nickajack Lakes. Sites were selected using Recon data (fish IBIs and macroinvertebrate EPT scores) where results were fair or poor and where fecal, turbidity, and nutrient data would be beneficial to understand the issues. The RAT asked the City Stormwater Management Division, the Tennessee Department of Environment and Conservation Water Pollution Control Division, and community groups to suggest other sites. We recruited volunteers by speaking about the opportunity at various meetings and placing short announcements in publications and local newspapers. Volunteers were asked to collect 10 fecal coliforms samples in WhirlPak bags (plus one duplicate) and 5 water chemistry samples in 250 mL plastic sample containers (plus one duplicate) over a 4-week period in July 1996. The Chickamauga/Nickajack RAT set up a laboratory and used volunteers to help process water samples for nutrients, turbidity, pH, total dissolved solids (TDS), and conductivity. Duplicate water samples were processed in TVA's Water Chemistry Lab as part of the QA/QC plan. The biggest problems with the program were getting fecal samples to the lab in time, poor WhirlPak technique, incomplete data sets, heavy workloads in the lab, conflicting demands on volunteer time, interference bacteria from heavy rains, and lack of adequate communication. To improve the program, (1) volunteer time commitments need to be made clearer; (2) WhirlPak collection training should be improved (possibly certification), and (3) volunteer involvement in program planning should be initiated.

The real value of the program turned out to be not the data, but the outcomes. Here are some examples: (1) Wolftever Creek: Data showed fecal problems in two creeks--Little Wolftever and Long Savannah. The Natural Resources Conservation Services (NRCS) is working with a farmer and volunteers from the summer program to implement a BMP on Little Wolftever; (2) Signal Mountain, TN: Citizens were convinced that septic tanks were failing and contaminating their creeks, and did not believe city and state data which showed that fecals were not a problem. Data using a volunteer from the area to collect the samples supported other TVA, city, and state data which showed fecal coliforms are not excessive; (3) Black Creek: Fecal data confirmed the impacts of a septic tank line break; (4) Mountain Creek: Area residents claimed that wading and swimming in Mountain Creek below Morrison Springs Road would make you sick. While interference bacteria made the data unusable, the data confirms the creek is filled with large numbers of some type of bacteria and CMSD plans to investigate this problem; and (5) North Chickamauga Creek: The data confirms that the new sewer line on Middle Valley/Boy Scout Road is beginning to have a positive effect on lowering fecal coliforms.

Trout Unlimited Volunteer Sediment Monitoring and Trout Stream Restoration Project

The Hiawassee River supports excellent trout and smallmouth bass fisheries and several threatened and endangered fish species, but sediment was threatening the resource. Pinpointing the sources of sediment loading is very difficult, time consuming, and costly. The team needed local volunteer help and support if they were to undertake the project. Before RAT teams were formed, TVA worked on a Trout Stream Restoration Project in this area to remove Rainbow Trout, isolate upper stream reaches, and reintroduce native Brook Trout with the National Park Service (NPS) and the U.S. Fish and Wildlife Service (USFWS). Local Trout Unlimited (TU) Chapter members participated in the restoration. Because local interest in fly fishing had always been high, TU members were happy to partner with the RAT to help pinpoint sediment sources. In 1995, the Hiawassee RAT and TU volunteers installed 12 sediment samplers vertically on posts in 12 tributary rivers to capture sediment. The TU chapter organized the volunteers to collect the samples after rain events and record rainfall data to correlate with the sediment data. Samples were analyzed at TVA's Environmental Chemistry Lab to determine suspended solid loads. Using the results from the 1995 season, some samplers were relocated to the mouths of other tributaries in 1996 and the project continued. As a result of this project, sediment sources were located and areas for stream bank stabilization and/or other BMP work identified. TU volunteers and other community members are an integral part of the restoration efforts. The community has now formed a Hiawassee River Watershed Association to address this and other issues.

North Chickamauga Creek Greenway School-based Acid Mine Draining Monitoring Project

The Friends of the North Chickamauga Creek Greenway (FNCCG), a multi-agency task force, applied for and received several grants to control acid mine drainage by installing constructed wetlands at several key sites at abandoned shaft-type coal mines on Waldens Ridge at the headwaters of North Chickamauga Creek. FNCCG needed data to demonstrate that constructed wetlands were working and to qualify for a Tennessee State/EPA 319 grant. The Chickamauga-Nickajack RAT and FNCCG decided the solution was to develop a school-based volunteer water quality monitoring program to monitor the effectiveness of the BMPs and educate area residents about the problems facing North Chickamauga Creek. High quality water quality data was needed which would be comparable with professional data being collected with a Hydrolab . The Corning Checkmate , a multi-sampler probe which tests for temperature, pH, dissolved oxygen, conductivity, and total dissolved solids, was chosen because it would provide reliable data at a relatively low cost and could be operated by teachers and students. In 1995, a grant for $5,000 from the Fish and Wildlife Foundation - Southern Rivers Council was obtained to buy probes and begin the program. Five local schools and the county Center for Advanced Sciences (CAS) agreed to participate and were trained in two 3-hour workshops. Teachers collect samples 4 times a year with their students. Probes and waders are loaned out from the CAS, which calibrates and maintains them. Supplies and forms are provided to each school at the training workshop. Teachers send

data to a centralized point and a report is prepared annually. Participating students serve as ambassadors of the creek and educate the whole community about its condition. FNCCG has received a second grant of to expand the program in 1996-1997.

Lessons learned

TVA CWI has learned a lot about networking since our inception in 1993, and we continue to learn every day. The most important lessons we have learned are to:

> **Find common ground:** Use this as a basis for involvement. Once you have your foot in the door, take your lead from the community and go where they want to go. The community will eventually work on issues you think are important, when they are ready (if the issues are important to them).
>
> **A picture is worth a thousand words:** Give community members an opportunity to see problems in their watersheds firsthand and to draw their own conclusions. Agency data sets don't mean much to the average citizen despite our best efforts to make the information "user friendly." Seeing is believing!
>
> **Be flexible about QA/QC:** Volunteer data may or may not be done with sufficient QA/QC for state, federal, and local agencies to accept, but the quality is always good enough to spur additional volunteer interest. Set a goal to improve quality, but be understanding and flexible. As volunteers understand the importance of quality, their quality will improve. If volunteers' data indicates a problem, you can always find a way to verify their findings.
>
> **Let them "dial for dollars":** Resist the urge to use agency monies to solve problems. Let communities find their own resources to address the issues; help out with "seed money" and in-kind services. People appreciate problems more when they are put in the position of having to find their own solutions and resources. This strategy keeps the group independent and makes it more likely the group will continue later without agency help.
>
> **Keep the faith:** The most important thing we learned is to have faith in people. They care about their communities and their water resources. Even if they are slow to act, when they do, it will be for the long haul.

Basics of Using School-Aged Monitors in the Classroom

Moderator: **Molly MacGregor,** Mississippi Headwaters Board
Panelists: **Mike Beauchene** and **Lisa Wahle,** Connecticut Department of Environmental Education; **Wilbert Odem,** Northern Arizona University; **Herb Turner,*** Conservation Federation of Missouri; **Libby McCann,** Adopt-A-Lake and Project WET

Michael Beauchene & Lisa Wahle
Project SEARCH, Science Center of Connecticut/CT Department of Environmental Protection, 950 Trout Brook Drive, West Hartford, CT 06119, 860/424-3655

Project SEARCH: A Practical Application of Environmental Science for High School Students

Generally, Americans have a poor understanding of scientific methods and principles, especially with respect to the study and management of ecosystems. This lack of understanding may be attributed to a lack of exposure to the subject. In today's society environmental regulation, utilization, and conservation are daily headlines. The general public is sometimes skeptical or mystified by the environmental research which leads to the management of natural resources. In order to alleviate this "scientific anxiety," exposure to the science must come through nonconfrontational education. Although some high schools offer elective ecology courses, students taking required science classes are rarely exposed to ecological studies. This is due to curriculum constraints and teachers with little or no experience in conducting field research.

What is SEARCH?

Project SEARCH is a National Science Foundation (NSF)-funded teacher enhancement program administered through the Science Center of Connecticut (SCC) and the Connecticut Department of Environmental Protection (CT DEP). Specifically, the grant provides teachers from public and private high schools with 144 hours of training in water quality monitoring, wetland evaluation, and effects of land use on water quality over a three-year period. Under the guidance of the trained teachers, students use monitoring equipment and scientific techniques to produce valuable water quality data. This data is then assimilated into formal reports (including the 305(b) Report to Congress) which are usable by public and private agencies to compile water quality information on Connecticut streams.

The goals of the project are twofold. First, SEARCH strives to provide comprehensive training and equipment to high school teachers so that they can implement a water quality monitoring program in their schools. Through the trained teachers, the program then provides students with valuable hands-on education about scientific data collection and analysis. Secondly, the project aims to provide community organizations such as watershed associations, environmental organizations, and municipal commissions, as well as the CT DEP, with "red flag" data for use in initial water quality evaluations.

Two teachers per school are trained and equipped to perform stream monitoring and wetland delineation and evaluation. Stream monitoring involves chemical, bacterial and macroinvertebrate sampling based on a rigorous quality assurance/quality control (QA/QC) plan. Wetland delineation exercises are based on criteria developed by the Army Corps of Engineers. Functional wetland evaluations are conducted using a CT DEP procedure. SEARCH staff review school data and annual reports for accuracy, and alert CT DEP Water Bureau personnel to sites showing abnormalities. Teachers are

encouraged to provide water quality data and wetland evaluations to municipal commissions. SEARCH staff provides ongoing support through workshops, field visits, and regular contact.

Since the summer of 1994, 136 teachers from 77 high schools have been trained. Seventy-four of those schools have active programs. Through Project SEARCH, many students have developed an awareness of stream ecosystems and the human impacts on these watersheds. Students are often more inspired and conscientious about their work, knowing their data will be submitted to CT DEP officials. Several students have gone on to pursue college degrees in related fields.

While teachers embrace the goals of the project, many express frustration at the amount of time it requires and at the ambiguities inherent in field investigations. The macroinvertebrate studies and scientific report writing aspects of the program have proved to be the most challenging to implement. Despite these concerns, formal independent evaluation has documented curricular change in all case study schools. The two largest changes are newly designed lesson plans which foster critical thinking skills, and interdisciplinary connections across both science and non-science disciplines. Long-term sustainability of the program will depend on having an internal and external support structure in place prior to the end of the grant.

How does SEARCH work?

To meet the first goal of the grant (i.e., hands-on science education), each school first selects a site of local interest. Once a site has been identified, the students begin to collect information on various physical, chemical, and biological parameters established by the SEARCH staff (see table). The students are responsible for monitoring their specific stream location twice in the fall and twice in the spring.

To meet the second goal (producing usable data), three issues need to be addressed. First, in order for SEARCH schools to draw accurate conclusions about water quality, the site must meet minimum requirements--specifically, it must be a riffle (a shallow, fast-moving section of a stream which has a heterogeneous inorganic substrate). Students select an appropriate monitoring site by following methodologies for Protocol 3 set by the United States Environmental Protection Agency (EPA) in Rapid Bioassessment Protocols for Streams and Rivers (Plafkin et al., 1989).

Second, the data generated must be reliable. To ensure reliable data, the project follows a quality assurance/quality control (QA/QC) program according to EPA QA/QC project plan recommendations. A major component of this plan involves taking duplicate samples at each site. SEARCH staff collect a water sample alongside the students. The duplicate sample is then tested by the State of Connecticut Public Health Laboratory for chemical parameters and fecal coliform bacteria. If discrepancies are found between the two, project staff identify possible causes.

Finally, rigorous hands-on teacher training covers all facets of water quality monitoring. Details of the training are described in the Project SEARCH Water Quality Monitoring Manual. Each school receives the necessary equipment to perform the monitoring tasks, and staff assistance in the field is provided to assure standard protocols are followed.

What has happened with Project SEARCH to date?

The following is excerpted from the executive summary for the 1995 annual report to NSF:

> *This 1995 report will provide a complete analysis of the project's first year, and preliminary information on planned activities for the upcoming year. To date, project expenditures total $484,533 and the project is tracking as planned. A current budget analysis is also included in this report.*
>
> *Project SEARCH is in its second full year of activity with 136 trained science teachers representing 77 Connecticut public and private high schools. This represents 57% of the project's goal of establishing Project SEARCH in 136 high school science curriculums over the five year grant period. Preliminary data estimates that upwards of 2,200 grade 9-12 students will be participating in Project SEARCH during the 1995-96 school year.*
>
> *Seventy-one percent of the first-year schools submitted final reports or data on stream water quality to the CT DEP. Results of the project's QA/QC program have found scientific data (four chemical test parameters) produced by the students to be consistent at the 90% confidence level. Accuracy of macroinvertebrate identification to the family level has increased by 65% to be 90% accurate (primarily due to a dichotomous key produced by SEARCH staff).*

Although SEARCH content and methods are rigorous in nature, understanding of the scientific concepts and procedures is not the primary problem. Rather, the main problem is difficulty on the part of teachers in integrating the program components within the constraints of current science curricula. Project staff are looking to address this issue in the coming year.

Further issues

Points that were emphasized in a formal evaluation of Project SEARCH included:

- SEARCH provided an institutional rationale for change from a conventional, abstract curriculum with an antiquated vision of science to one which is active, relevant, and dedicated to current techniques and strategies of scientific process of inquiry.
- A continuing tension is the focus on excellence with regard to the reports submitted to CT DEP. This concern with report quality may be taken as a focus on product, whereas a greater contribution of SEARCH is to imbue knowledge

and appreciation for the scientific process, i.e., the asking and researching of questions with curiosity, rigor, and accuracy. If the focus remains on quality reports, some teachers may write the report themselves, short-cutting the process for something that "looks good."

- How can SEARCH assist schools that have financial burdens which could make the program impossible?
- Teachers' responses indicate high quality in training and in onsite field assistance, which they felt was crucial. SEARCH staff helped them also on pedagogical processes, which led to experimentation with different groupings of students and expanded evaluation techniques to include the participatory process. The implementation provided much greater variance than anticipated. How might SEARCH assist in disseminating the different models of implementation and help floundering teachers to network with successful ones?
- The effects of SEARCH on low-achieving students were positive, yet teachers need encouragement to continue working with a range of students and to focus on process as well as product.

In summary, Project SEARCH has been successful at meeting both of the project's goals. Although work remains to assist teachers in implementing the program and becoming comfortable with the rigorous standards, participants are producing usable data (from 13 sites) as reported in the 1996 305(b) Report to Congress.

Reference:

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish.* EPA/444/4-89-001. U.S. Environmental Protection Agency, Assessment and Watershed Assessment Protection Division, Washington, DC.

Wilbert Odem
North Arizona University, 1911 N. Marion Drive, Flagstaff, AZ 86001, 520/774-7005

Verde Watershed Watch Network

The Verde Watershed Watch Network (VWWN) is a consortium consisting of Northern Arizona University and seven high schools in the Verde River Watershed. VWWN exists to provide water quality monitoring along the Verde River to detect nonpoint sources of pollution and to propose best management practices that can alleviate and prevent deterioration of the aquatic ecosystem(s). This effort is jointly funded by the U.S. Environmental Protection Agency (through Section 319 of the National Monitoring Program of the Clean Water Act) and the Arizona Board of Regents under the Eisenhower Science and Math Education program. The project is funded for three years, during which time data is given to the Arizona Department of Environmental Quality (ADEQ) for their records.

Three teachers from each school (two science and one social science) are trained at workshops in sampling, analysis, and quality control techniques. Teachers are introduced

to data management approaches, geographical information systems (GIS), telecommunications, and regulatory concerns. In turn, the teachers incorporate this training into their school curricula, teaching their students to perform the sampling and analyses. In addition, the teacher training workshops discuss integration of water resources with socioeconomic issues in the watershed and how decisions on water issues can affect community growth and activities. The funding provides stipends for teachers to attend the workshops, travel costs, sampling and analysis equipment, and computers. To date, workshops have focused on sampling for macroinvertebrates, flow measurements, GIS, water chemistry, watershed issues, and telecommunications.

Each school is responsible for sampling two sites, with each site consisting of an upstream (control) and a downstream (impact) location. Sampling is done monthly for pH, temperature, chlorine, dissolved oxygen, electrical conductivity, flow, turbidity, and nitrates. Twice a year, in the spring and fall, each school samples macroinvertebrates. The field data forms and samples are sent monthly to North Arizona University, where the data is compiled for submission to ADEQ. A protocol has been established for cases where measurements exceed allowable levels. No excesses have been found so far. Sites were chosen to allow for the investigation of impacts from a variety of potential sources including agriculture, mining, urban runoff, cattle grazing, and on-site wastewater disposal.

The following are some of the "headaches" or obstacles we have encountered and have been able to surmount.

Funding issues Matching funds, funding agency reporting disparities, category constraints, individual school contributions, and account management.

Institutional issues

Each institution involved in the project operates differently. The following institutions participate in this project and thus have input and some "control": U.S. Environmental Protection Agency, Arizona Department of Environmental Quality, Arizona Board of Regents, U.S. Department of Education, Chino Valley High School, Flagstaff High School, Mingus Union High School, Oak Creek Ranch School, Prescott High School, Sedona Red Rock High School, Verde Valley School, and North Arizona University.

Technical issues

Wide range of teacher backgrounds, variable comfort levels with equipment, and wide range of competencies expected of teachers for project execution.

Political issues

School boards, federal agencies, state agencies, and political issues operating within institutions.

Curricular issues

How does this project get incorporated into curricula? into science? into social science? Will state education standards still be satisfied? Curricular differences between private and public schools.

Social science issues

How will the science feed into social science? What types of training needs exist?

The project has experienced a variety of unexpected turns, related to, among other things, political issues, institutional hurdles, and school schedules. But there have been very positive effects on school curricula, teacher morale, and watershed/water quality awareness. This conference will allow us to learn from other projects, share the knowledge we've gained, and reinforce the efforts to create a widespread watershed-based involvement in water resources in the Verde Valley.

Libby McCann
Adopt-A-Lake and Project WET Coordinator, University of Wisconsin College of Natural Resources, Stevens Point, WI 54481-3897, 715/346-3366

Adopt-A-Lake: A Unique Approach to Classroom and Community Education

Adopt-A-Lake is a K-12, interdisciplinary, hands-on program that encourages young people to learn about inland lakes in Wisconsin while actively working to protect those resources. The program also emphasizes collaboration between youth and adults to protect lakes in their community. Youth groups have been involved in a variety of Adopt-A-Lake projects, often investigating lake management issues from a variety of perspectives (e.g., ecological, social, and historical points of view) while working in conjunction with other concerned citizens of all ages within their community. These youth groups and their adult leaders or teachers have been involved in water quality monitoring, field trips, independent and group lake studies, litter cleanups, community surveys, lake ecology workshops, presentations about their lake to community members, and other projects to help increase awareness about lake protection. The following information helps define how Adopt-A-Lake often goes beyond water quality monitoring in the classroom to help build a sense of community between young people and adults concerned with lake protection.

Wisconsin's watery jewels

Wisconsin citizens of all ages are highly motivated to learn, work cooperatively, and take action on behalf of lakes because of the central role these "watery jewels" play in the lives of Wisconsin's residents and visitors. Wisconsin's glacial history has left a legacy of over 15,000 beautiful lakes. Most of these lakes are found in the northern and eastern regions of the state, dotting the path of the glaciers. The people of Wisconsin, and those

who vacation here, have long appreciated these lakes for their recreational, economic, natural, and aesthetic values.

In recent years, the demands on Wisconsin's lake resources have increased dramatically. Shoreline development is contributing to increased sedimentation and displacing valuable habitat. Nutrients like nitrates and phosphates from sewage and surface runoff are choking lakes with algae and plant growth. The introduction of hazardous materials into lakes also threatens these fragile aquatic communities. Such phrases as exotic species, user conflicts, and cultural eutrophication (the accumulation of dissolved nutrients due to pollution) have become common terminology in the struggles to protect lake resources. Educating people of all ages and cooperating at the community level are vital to understanding and solving the complex issues involved with lake management.

As water issues--and particularly lake issues--at the local, national, and even global levels become more critical, ordinary citizens and policy leaders are being asked to make tough decisions. To participate effectively in the decision-making process, citizens require accurate, current, and understandable information on the complex issues involved. Education provides the link to effective public participation.

As a youth education initiative of the Wisconsin Lakes Partnership--a collaborative effort among the University of Wisconsin-Extension (UWEX), the Department of Natural Resources (DNR), and citizens, primarily represented by the Wisconsin Association of Lakes (WAL), Adopt-A-Lake offers an excellent framework for intergenerational education as school and youth groups become involved with local lake organizations and professional resource managers. Adopt-A-Lake encourages young people to collaborate with these professionals and volunteers who can be role models for lifelong learning and mentors for environmental stewardship. Cooperation among youth and community organizations enhances commitment to the protection of lakes and develops a stronger sense of common vision among those individuals involved.

With regard to water quality monitoring, a key advantage of the Wisconsin Lakes Partnership is that students and other youth groups involved with Adopt-A-Lake are able to pursue monitoring through the Department of Natural Resources' Self-Help Lake Monitoring Program. Over 900 citizens statewide collect lake water quality and habitat data as Self-Help Lake Monitoring volunteers. Self-Help Lake Monitoring and Adopt-A-Lake staff work in collaboration to provide teachers, youth leaders, and youth with the training, materials, and equipment necessary for lake monitoring. Depending on the age and interests of the students, monitoring can include investigating water clarity, water chemistry, aquatic plants, and exotic species, among other areas related to the life of the lake. Monitoring a lake provides students with "real world" experience as their data are used in lake management decisions at the local, state, and federal levels.

Adopt-A-Lake program primer

There are a variety of unique and exciting Adopt-A-Lake projects occurring throughout Wisconsin, ranging from organizing young people to interview community members

about their lake to designing educational programs to increase community awareness about exotic species. Other projects include litter cleanups and storm drain stenciling. Despite variations in communities and approaches, there are common requirements youth groups and schools interested in the program should fulfill. The following lists criteria by which Adopt-A-Lake projects are recognized at the state level. These criteria are by no means an exhaustive list, but are intended to help groups in developing their lake projects while also providing Adopt-A-Lake staff with guidance in recognizing program participants and determining the services they need.

The following criteria are continually being refined. They are based primarily on the suggestions of participants and are intended to give interested schools and other youth groups an idea of what is unique about the Adopt-A-Lake approach.

Community involvement

We want youth to develop lake projects of interest and importance to them while also working with others in the community (e.g., lake organizations, civic groups, businesses, etc.) interested in lake protection. Cooperation among youth of a community and lake management organizations will enhance community commitment to the protection of lakes.

Commitment

The idea of "adopting" a lake suggests a long-term commitment to preserving, protecting, and appreciating the value of that resource. Therefore, groups involved in an ongoing Adopt-A-Lake project of two years or longer will be given higher priority for receiving an Adopt-A-Lake sign than groups involved in one-time events. (Note: These Adopt-A-Lake signs, measuring 30 by 36 inches, identify the lake being "adopted" as well as the sponsoring group(s), and can be placed either at the lake site, near the town sign, or at another location the group determines to be appropriate.)

Creative and interdisciplinary approach

We encourage youth to investigate lake issues from a variety of perspectives, including historical, cultural, social, and ecological.

Learner-centered

We encourage youth to be involved in all stages of their project from planning to implementation.

Action-oriented Lake education and action are crucial for lake protection. Action projects include activities like lake monitoring, letter-writing campaigns, litter cleanups, community surveys, presentations, and storm drain stenciling. Hands-on activities like these provide youth with the skills and motivation to protect their lake and be a positive force within their communities, now and in the future.

North Lakeland Elementary: A case study

North Lakeland Elementary School is in the northern region of Wisconsin, where the state's glacial history has dotted the landscape with a legacy of lakes. The nearest town is Manitowish Waters, a community of approximately 650 located in Vilas County--one of the densest areas of lakes in the world, with over 1,327 lakes within its borders. The town is situated in an idyllic setting amidst abundant wildlife, spectacular lakefront vistas, and the peace and quiet that accompany the slower-paced life in more rural American communities.

As in many northern Wisconsin communities, the lakes in this region are facing a variety of potential environmental disturbances--increased use and shoreline development can strain these unique water ecosystems by increasing sedimentation and nutrients. Other problems associated with lakes include toxic contamination, lake user conflicts, loss of exotic species, and acid rain.

As concern about protecting lake resources has grown among community members, so too has the concern and interest of local teachers and students. In 1995, this interest led to the pursuit of a lake protection grant through the Department of Natural Resources to establish a "Mock Lake Association" curriculum and student program at North Lakeland Elementary School. A $10,000 grant was awarded in the spring of 1995, and since that time teachers, students, and other community members have become actively involved in learning more about the lakes in their area and how to protect these resources.

Under the guidance of Jan Watras, a Technical Education teacher at North Lakeland, a variety of activities have been undertaken to interest students and teachers in lake protection. Grades 5-7 and a multi-age classroom (1-4) chose several lakes to be "adopted" for the project. The school incorporated the Adopt-A-Lake program into their Outdoor Education Curriculum for grades 5,6, and 7. Students spent one day in the fall, winter, and spring seasons collecting data on the lakes chosen. Younger students made Secchi disks (black and white disks used to measure water clarity) and took readings using them. Others surveyed the lake shoreline, measured water temperatures, collected water samples for laboratory tests, learned the lakes' special features (e.g., size and depth), and studied the types of plant and animal life in the area. They also collected and identified macroinvertebrates (aquatic insects visible to the naked eye).

An interdisciplinary approach is a key element to this Adopt-A-Lake project. The school's Adopt-A-Lake activities were incorporated into many areas of the curriculum before and after the "field work." Students made graphs in math classes, wrote about their findings, and incorporated their water testing into science class. Students also kept a journal about their lake experiences and created three-dimensional maps of the lakes, showing their depths, shapes, and other information.

The 5th through 8th grades elected officials and formed "mock lake associations," providing students an opportunity to better understand some of the social and political dynamics that occur within these organizations. Students gained civic skills by learning

how to conduct a meeting, elect officers, and accomplish goals through their lake association.

One of the culminating events from this Adopt-A-Lake project was the students' presentation at the Wisconsin Lakes Convention in Stevens Point, WI. Every year, this convention attracts over 700 people--lake residents, public officials, lake association members, resource managers, and other citizens interested in protecting Wisconsin's inland lake resources. Through their presentations, young people have brought a new energy to lake protection in the state, educating and inspiring citizens of all ages to protect Wisconsin's lakes. Community members are excited to see and hear from youth who are successfully implementing lake protection projects, and the students are gaining valuable skills to help them effectively participate in decision-making processes.

According to Watras, "The students loved presenting at the Lakes Convention and to the Parent Teacher League (PTL) in their community. Last summer they presented to the lake association and have encouraged other students to get involved." Most of the students mentioned that this exposure to scientific studies made them think about a career in science, while adopting a lake made them aware of the importance of preserving these natural resources.

Making community-classroom connections: Opportunities and barriers

Watras emphasizes the importance of having administrative and community support in the implementation of any educational project like Adopt-A-Lake. She suggests calling local newspapers and television stations with news about your project. "We worked to keep everyone informed," says Watras.

Another component that helped make the North Lakeland Elementary School Adopt-A-Lake project successful was the concerted effort among teachers, students, community members, and lake specialists. According to Watras, "Most people were very excited about the project. The local lake associations provided pontoon boats and local resorts provided a place along the shoreline where students could have access to the lake." The Department of Natural Resources also supplied extra Secchi disks and useful reference materials. University of Wisconsin-Extension agents and specialists spoke to students about lakes. Lake experts from the University of Wisconsin Trout Lake Research Station were brought in to explain water chemistry techniques.

One of the first steps in the process was gaining teacher and community support. To that end, two teacher trainings on lake ecology, water monitoring, and infusing water-based environmental education activities into the school curriculum were offered to North Lakeland teachers. Lake association members, water quality specialists, and other community members were also invited to attend these workshops, which helped build a camaraderie among project participants.

"As far as barriers," says Watras, "we had trouble getting students onto the lake during bad weather and had some troubles with the boats that wouldn't operate, but we made

alternate plans when we couldn't get out on the lake." Despite the logistical barriers to the project, Watras and other teachers in the area hope to continue to share their project and lake results with teachers, young people, lake association members, and community members on an annual basis. Hopefully, their enthusiasm and newly gained knowledge about lakes will help both students and teachers reach that goal.

Conclusion

Adopt-A-Lake works to go beyond water quality monitoring in the classroom to help build a sense of community among young people and adults concerned with lake protection. Every community has unique natural features worth preserving for future generations to enjoy. From lakes and streams to prairies, parks and garden plots, there are areas that can provide a focal point for building a sense of community as people work together to protect those resources.

Hopefully, other communities can learn from the Adopt-A-Lake approach, adapting its successes to fit their unique needs. Such approaches can ultimately result in a more informed citizenry with the skills, knowledge, and interest to take a stake in their lakes and other natural resources that are so vital to communities worldwide.

Getting in Step: A Pathway to Effective Outreach in Your Watershed

Workshop Leaders: **Barry Tonning,** Gateway District Health Dept., and **Charlie MacPherson,** Tetra Tech, Inc.

Charlie MacPherson
Public Outreach Coordinator, Tetra Tech., Inc., 10306 Eaton Place, Suite 340, Fairfax, VA 22030, 703/385-6000

Barry Tonning
Nonpoint Source Project Director, Gateway District Health Department, Gudgell Avenue, Owingsville, KY 40360, 606/674-6396

Getting in step

Is your message being heard? Is it being heard by the people who need to hear it? The key to successful outreach is targeting your message to a specific audience and getting the audience to respond to your message. There is a definite pathway, or process, to follow to achieve effective outreach in your watershed. How many times has your organization started to do a fact sheet or a newsletter before deciding what they want to say and who they want to say it to? By following the pathway we suggest, your organization can prepare targeted outreach materials to satisfy the goals and objectives of your program. This session will review the basic building blocks to effective outreach

and then focus on enhancing outreach materials and using the media to get your message out.

Building blocks

There are six essential building blocks to effective outreach. Each block builds on the previous block and each block is essential to achieving the desired result. By using these building blocks you can build a pathway to successful outreach in your watershed!

Block 1: Define your objective

First you must decide what you want to accomplish. Your objective should be specific and results-oriented. The more specific you make your objective, the easier it will be to develop your message, identify your target audience, and evaluate the success of your outreach efforts. For example, if you state your objective as "Teaching the general public about nonpoint source pollution," you will have a very difficult time evaluating the success of your efforts due to the vague objective and unwieldy target audience. Restating your objective as, "Educating homeowners with lawns about proper techniques for fertilizer application to reduce the amount of nitrogen and phosphorus runoff into nearby streams" will help target your message and increase the likelihood of the audience hearing your message.

Block 2: Identify your target audience

Once you have defined your objective, you must decide whom you are trying to reach. Chances are you will identify several different target audiences for each objective. The more specific you make your audiences, the easier it will be to target your message for those audiences. Once you have identified an audience, you need to collect information about the members of that audience (e.g., their demographic make up, their knowledge about the topic to be discussed, their attitudes about the subject of your message, and which communication channels they use). You will use this information to develop a message that is targeted to your audience's needs and to develop and apply the kinds of formats they are likely to encounter. Several resources are available for collecting the above information. In addition to the Census Bureau or marketing research firms, resources include the following:

- **Focus groups.** Ask five to seven members of your target audience to participate in a 1- to 2-hour facilitated discussion of the issues under consideration. Make sure your facilitator is well versed on these issues.
- **Convenient samples.** Identify where you can easily access your target audience and ask a subset population a series of questions to gain insight. For example, if you want to find out about habits of people who change their own oil, an auto parts store might be a good place to find members of your target audience.
- **Trade associations.** Talk to trade associations to gather information about their members. For example, boating associations can provide insights as to why their members sometimes discharge sewage into coastal waters instead of using

pumpout stations. You might discover that most boaters are unaware of pumpout locations, leading you to develop a message that includes locations of the pumpout stations in the area.

Block 3: Develop your message

Now that you are armed with all kinds of background information on your target audience, you are ready to develop the message. The message you send out should not be your objective. Your message will help you to meet your objective, especially if it is specific, shows a benefit to your audience, and is action-oriented. Put yourself in the position of your target audience and ask yourself the questions they will ask: "Why should I care about this? What's in it for me?" Specific benefits for your audience might include: free implementation of the plan in question, convenient steps to activate the plan, improved health for the people involved, the fulfillment of legal statutes, saving time, and saving money. For example, when educating homeowners about how leaky toilets waste water, mention the dollar amounts the consumer pays per day for a leaky toilet and explain how such leakage depletes natural resources.

Block 4: Prepare your formats

How are you going to display your message? To achieve maximum impact, several different formats should be used. Formats include print materials such as fact sheets, newsletters, flyers, and posters; promotional items such as magnets, bumper stickers, rulers, and tote bags; and media outlets such as radio and TV public service announcements and news stories.

To help determine your format, decide what you want your audience to do with the message. For example, if you create a flyer your audience will read once and then throw away, then you might want to produce your flyer on recycled paper. For messages that you want your audience to refer to repeatedly, refrigerator magnets are an inexpensive format that keeps a message visible. Promotional items, which can be given away at events and festivals, spread your message and increase recognition of your organization's name. Radio and TV public service announcements are useful formats to advertise upcoming events, or the release of an important environmental report. Use these outlets sparingly, making sure your messages are time-sensitive and will appeal to a large audience.

Block 5: Identify distribution mechanisms

Often the flyer or fact sheet has been printed before anyone asks, "How are we going to get this to our target audience?" It is important to know the distribution mechanism for your message before you develop any outreach materials. This mechanism will affect your budget planning (postage costs add up), the design of your format, and the selection of trade associations or organizations to be used in disseminating your message.

Possible distribution mechanisms include mail, trade associations, community organizations, door-to-door dissemination, phone calls, events, mass transit, billboards, and media outlets. In addition, phone directories for the United States are now available on CD ROM that allow you to target your audience by ZIP code, as well as through a variety of coded trade associations.

Block 6: Develop and conduct your evaluation

How do you know if your outreach effort worked, or, more importantly, didn't work? It is critical to assess your efforts and to evaluate specific components to improve or modify your future outreach efforts. Review your objective and turn it into a question. For example, if your objective is to recruit new members for your volunteer monitoring organization, your question should be, "Are we recruiting new members for our organization?" If the answer is yes, you can make your evaluation more specific:

- How many new members have we recruited?
- Are the new members from our target audience?
- Has the target audience seen our message?
- Has the target audience understood our message?

Once you know the questions to ask, select the techniques that will provide the answers. Phone surveys and questionnaires are commonly used to solicit information from the target audience.

Eye-catching outreach materials

Once you have chosen the formats for getting your message out, how can you maximize the chances that your target audience will see and respond to your message? Through the use of text, design, graphics, photographs, and hooks you can easily and cost-effectively enhance your materials to grab people's attention.

- **Design.** When designing your outreach materials, use restraint. There are lots of creative ideas out there, but select only two or three elements to use on one piece. The use of white space will greatly enhance the overall look of your message. Think of white space as a graphic in and of itself. In addition to different types of text, fonts are increasingly used as design elements. Fonts can be stretched, wrapped, reversed, enlarged, turned sideways, or repeated to create visually appealing materials. When designing pieces, try to adhere to the 2/3 vs. 1/3 rule: fill 2/3 of your page with graphics and only 1/3 of the page with text.
- **Graphics.** Graphics should be used whenever possible to highlight concepts, break up blocks of text, and create areas of white space. Make your graphics large enough to have an impact. When using graphics, be sure they photocopy well. Line drawings work best. If you have a limited graphics library, repeat the same graphic across the page, or vary the sizes of the graphic and group them together. Avoid using several different graphics of the same size on a page. This diminishes the impact of all the graphics on the page.

- **Photographs.** Photographs can be incorporated into outreach materials, but make sure that each photograph will reproduce well and is relevant to the piece. It is much better to use a clear line drawing than to use a fuzzy, washed-out photo. Photos of people are usually best. Most people love reading about other people. Again, if your material will be photocopied, photographs might not be your best choice.
- **Color.** Use color! At the very least use colored paper for your fact sheets and flyers. You are competing with lots of printed information out there and color gets you noticed. Paper has come a long way in terms of the many types of recycled paper now available and the variety of colors that photocopy well. People often photocopy flyers or brochures in black ink because they believe it costs less than color copying, but the difference in cost is actually quite small and well worth the improved results. Blue, purple, and green work best for pieces with a large amount of text. Two-color printing provides a good balance of artistic creativity at a reasonable cost. By overlapping two colors, you can create a third color, while the use of screens and halftones provides various shades of color. Four-color printing is the most expensive color process, but it can also be the most eye-catching. Four-color printing is particularly effective on maps and posters.
- **Hooks.** Several techniques can be used to engage readers if your message is lengthy and you want to "hook" them in. To involve the reader, try starting off with a startling question such as, "Are you poisoning your water?" Humor works well too. Most people enjoy games, so instead of explaining the information, display it as a game or contest. For example, phrase your information in the form of true/false questions, have the reader find 10 examples of pollution in an illustration, or design a crossword puzzle with nonpoint source pollution clues.
- **Text.** Many people spend a great deal of time preparing graphics and producing an award-winning layout only to throw in text that is wordy and uninteresting. Spend time making your text come alive to your readers. Once the text is written, take the time to shorten it. Avoid the use of acronyms and highly technical words.

Using the news media

News media coverage of water quality monitoring or remediation projects provides an inexpensive venue for informing and educating the public on problem issues and the management and behavioral practices recommended to resolve them.

Unfortunately, much of the current media coverage of water quality projects focuses heavily on peripheral matters (e.g., personalities, events, etc.) while providing little explanation of the specific problems, the science behind the problems, and the strategies used to address the problems. For instance, a story on the installation of a livestock waste-handling system usually discusses the producer, his operation, his family, and so forth, with little information on how the nutrients and pathogens in manure affect surface and subsurface water supplies, or how the new system will help the situation.

Using the news media to keep the public informed about water quality issues is relatively simple. Only two things are required. First and foremost, developing a relationship with

the appropriate reporter(s) will help foster an understanding of your monitoring group, its objectives, and the problems revealed by the data collected in the field. Taking reporters out on monitoring trips, for example, and providing them with a steady stream of timely news releases will add to your organization's credibility, improve public understanding of water quality issues, provide a boost for the troops in the field, and aid in volunteer recruitment.

The next thing to keep in mind is that the news always has to be new. Educational information on water quality issues must be accompanied by some sort of "news nugget" that is current, affects many people, involves an interesting local personality, has unique appeal, or relates the local situation to regional, state, or national issues. The general format for educational news releases is to first present the "news nugget" (think of what the headline will say - that's the news part) and then to explain how the problem in question affects water quality. For example, a story on a new oil recycling program at a local service station could be followed by a discussion on the toxic content of used motor oil, the fact that many people are still disposing of oil improperly, a review of the pathways dumped oil takes to water bodies, and the impact on aquatic life (and drinking water sources) that follows.

When you discuss scientific issues in news releases, it is very important not to get too technical. "Phytoplankton" are "algae" to the general public; "nutrients" are "algae-feeding substances"; and "nonpoint source" should be referred to as "runoff." Remember that reporters are usually juggling four or five stories at once, so don't load them down with a lot of reports or reams of data. They won't read more than two or three pages, so the object is to condense and simplify your message. It helps to hit the various problems (nutrient loading, sedimentation, streambank destruction, etc.) from several different angles throughout the year because:

Reach x Frequency = Results

You can't tell them just once that riparian vegetation is a good thing, just as soda pop companies don't ask you only once to buy their products. Promoting clean water in the news media is an ongoing affair.

CONCURRENT SESSION 3

Youth-Designed Restoration Projects

Moderator: **Karen Firehock,** IWLA
Panelists: **Rich Mason,** U.S. Fish and Wildlife Service; **Esther Lev,** The Wetlands Conservancy

Rich Mason

U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD 21401, 410/573-4584; email Rich_D_Mason@mail.fws.gov

School Yard Habitat Restoration Program

Background

In the past 10 years there has been a growing interest in creating backyard wildlife habitat. At the same time, schools have become more interested in attracting wildlife to the school yard. While the interest is high, there is a severe shortage of natural resource experts and education specialists available to provide training and assistance to schools in order to implement projects that are both educationally and ecologically valuable. Additionally, the techniques used in the backyard may or may not work as well in a school yard.

Pilot project

In 1993 the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office initiated a pilot project in Maryland designed to give students hands-on experience in restoring, creating, or enhancing wetlands, forests, and grassland meadows on school grounds. The thrust of this effort is to focus on naturalization projects and not on traditional backyard projects such as butterfly gardens, bird feeders, etc. The goal of the project is to challenge students to utilize mathematics, science, reading, writing, decision making, and critical thinking skills in a practical application that would benefit local and migratory wildlife. Students are challenged to plan, design, and monitor these projects. The new habitats are used as outdoor laboratories and are available for informal student investigation and discovery. The projects have a number of potential benefits including:

1. Provide an opportunity for students to use skills in a practical application
2. Create nearby natural areas for instructional use and informal investigation
3. Create better habitat for local and migratory wildlife
4. Improve the aesthetics of barren school landscapes
5. Reduce school facilities costs
6. Provide vegetative buffers to nearby streams
7. Provide natural areas for community use
8. Create a model of land stewardship for the community

The U.S. Fish and Wildlife Service provides the following types of assistance to schools: (1) offering 1-day training workshops for teachers, administrators, maintenance staff, and parents; (2) providing follow-up support and technical assistance; (3) developing a restoration guide for students to use; (4) working closely with the Maryland State Department of Education landscape architect division in promoting habitat conservation through natural design in new school construction and renovation projects; and (5) coordinating with other agencies on school projects.

The pilot program is taking place in Maryland, with plans to expand into other states in the Chesapeake Bay drainage. A few projects have been implemented or are being planned in Virginia and West Virginia. Pennsylvania has a new program that is being coordinated by the Pennsylvania Audubon. Virginia has a Gardening for Wildlife Program for schools.

Results

As of June 1996, approximately 60 projects have been completed and 25 acres of unused school lawn converted to meadows, forests, or wetlands. Several thousand students have been involved with these projects.

Esther Lev

The Wetlands Conservancy, P.O. Box 1195, Tualatin, Oregon 97062, 503/239-4065

Unlikely Partners: A Degraded Waterway, A Small Private Manufacturing Company, and an Alternative High School Program for At-Risk Youth

C.R.U.E. (Corps to Restore Urban Environments) is an alternative school program that is a partnership between Open Meadow Learning Center and The Wetlands Conservancy, a small non-profit land trust. The program is designed to teach young people how to identify environmental restoration needs within their community and to develop and install projects that fit the landscape and community needs. As much as possible, the projects are structured to have C.R.U.E. participants involved in all phases, including needs assessment; site evaluation and assessment; project description and design; discussing project design and goals with appropriate agency staff, landowners, and community members; drafting project blueprints and cross-sections; creating project budgets and timelines; project installation; execution of a monitoring program; and ongoing maintenance of the project. This process allows Corps participants to understand the process involved in doing small and large restoration projects and the need to develop partnerships with many agencies, neighborhood people, and other interested or impacted parties in order to complete such projects. It also exposes them to a variety of career options, ranging from horticulture (nursery work) to construction to government agency positions.

Project description

The Columbia Sloughthe quintessential urban streamis a degraded, channelized system with steep banks vegetated by the invasive exotic Himalayan blackberry. For the past four years students in the C.R.U.E. program have been transforming the banks of the Columbia Slough into a terraced, wetland/forested riparian community. So far, 25 students have been involved in rehabilitating close to 500 feet of the Slough.

In October 1993, seven youth designed a streambank restoration project and landscape plan for Atlas Copco Wagner Mining, Inc., a small private business along the Columbia Slough in Portland, Oregon. The crew spent three days on the site, mapping existing conditions and identifying site attributes, opportunities, and constraints. They interviewed the environmental manager for Atlas Copco Wagner Mining about the company's reason for doing the restoration project and employee needs, and the City of Portland Columbia watershed manager on her needs and wishes for cleaning up the slough. Day 2 was spent designing the project, including determining grade changes and terracing, drawing cross-sections, and finally developing a planting plan and plant species list. While working on the design on site, the youth were able to observe employees' use of and attitudes toward the site, and incorporate those observations into their design. Three teams of two youth each created designs. Each team presented their plan to the other groups and then to the "clientÓ for critique and input. Finally, they took components from each of the designs and created a composite design. The final drawing went through the City of Portland Environmental Zone permit process. One of the youth attended the pre-application meeting, made notes of what changes needed to occur to obtain the permit, and was then responsible for working with the rest of the team to make those changes. The permitting process took longer than expected, delaying the installation time for the project. The permit was finally obtained in June, the beginning of the hot dry season. Project installation was delayed until September 1994, the beginning of the rainy season. By this time, the youth who had designed the project had completed the program, so the project was installed by six different youth.

The second group of youth learned to read and fine-tune a planting plan. The design specified a wetland shelf with sedges, rushes, and cattails, and a riparian forest of red alder and big leaf maple along the slope. Twenty-five different native tree, shrub, and wetland emergent species were planted. In December of 1993, the Urban Streams Council obtained over 2,000 native riparian and wetland plants, to be used for the Columbia Slough rehabilitation project. Over the spring and summer, the plants had become root-bound in their containers. The second group of youth re-potted each of the 2,000 plants. This allowed them to become knowledgeable about each of the plant species and their growth patterns and location preferences. The planting plan was altered based on their new knowledge of the different plants. Six youth and three adult guest laborers spent six days rehabilitating 250 linear feet of slough bank, planting over 2,000 plants. The Multnomah Drainage District donated excavation equipment and time. Chicken wire cages were put around the majority of the trees and shrubs in order to limit nutria damage to the plants.

A third group of students monitored the project over the next six months, watching growth and survival rates, removing blackberries and reed canary grass, and developing an understory, forb, and low shrub planting plan. They installed the understory plantings in September 1995, once they felt the trees and shrubs had established an adequate canopy to support their growth.

The fourth group completed a two-week design course (similar to what the first group did). Unlike the first group's section of bank, which was primarily blackberry with few

native trees or plants, the fourth group's section had six native trees that will remain. The students had to incorporate the existing trees into their new design as well as integrate the elements of the earlier installation into their design. The design also included more human-use elements: several picnic tables, a small trail down to the slough, and a wildlife viewing platform. After completing the design course, the youth developed one composite plan, a detailed budget and timeline, and a monitoring and maintenance plan. In the spring of 1996 they installed the design, and they have been returning to the site once a month since May to weed exotic plants and monitor plant growth.

Conclusion

All parties involved feel the project was a success. Granted, the rehabilitation of 500 linear feet of slough bank along an 18-mile degraded system may have a very limited impact on fish and wildlife habitat and, in turn, species diversity and numbers, and the overall landscape ecology and health of the region. It is, however, the start. The project has changed a small landscape, as well as the perception of the slough by the employees of Atlas Copco Wagner Mining, and it has given the C.R.U.E. participants the opportunity to be responsible for making those changes. Hopefully, this project will become a catalyst for other property owners and residents along the slough to begin to rehabilitate the system. As more people get involved in these projects and see the changes, there is an opportunity to change how humans interact with the natural landscape, becoming better stewards of the region's natural resources.

Monitoring Wetlands

Moderator: **Christy Williams,** Izaak Walton League of America
Speakers: **Mitch Keiler,** Maryland Department of the Environment; **Linda Storm,*** USEPA Region 10; **Sarah Kneipp,** Caddo Lake Institute

Mitch Keiler

Maryland Dept. of the Environment, Water Management Administration, Nontidal Wetlands and Waterways Division 580 Taylor Ave., Annapolis, MD 21401, 410/974-2265

Maryland's Wetland Monitoring Program and Methodology

The Chesapeake Bay watershed is at risk from development and related causes of nonpoint source pollution. The problem is immense considering the 64,000-square-mile Bay watershed. Given the projected level of development within the Bay watershed, continued loss of some wetlands is unavoidable.

Federal and state regulations applying to wetlands can require compensation for impacts that result in wetland destruction or degradation. Mitigation for wetland loss in the form of wetland creation has become an accepted practice, and regulations require yearly monitoring of the site.

There is very little information available on the status of created wetlands. In their book Wetland Creation and Restoration: The Status of the Science, Jon Kusler and Mary Kentula report that "monitoring of wetland restoration and creation projects has been uncommon.Ó A review of the EPA National Directory of Volunteer Environmental Monitoring Programs, Fourth Edition (1994) shows that out of a handful of programs that monitor wetlands only one program in the United States is dedicated to using volunteers to monitor created wetlands.

Wetlands are designed to meet certain performance standards. Long-term monitoring of these sites is the only way we can judge if the created wetlands meet these standards. With state and federal budgets stretched to the limit, the practical alternative is to empower the citizenry to be actively involved in the management of our natural resources. Citizen volunteers have already demonstrated the ability to collect valuable data in support of state water quality monitoring programs. Monitoring newly created wetlands offers citizens a chance to learn about land restoration and the role wetlands play in helping protect water quality.

Scope of the mitigation monitoring program

The Maryland Department of the Environment (MDE) Water Management Administration (WMA) has organized and begun implementation of a citizen-based nontidal wetland mitigation monitoring program. This project has developed a monitoring manual and training seminars. Volunteers are trained to collect baseline data on vegetation density and groundwater elevations on state-developed programmatic wetland mitigation sites. Information gathered from this study provides resource managers with quantitative site-specific data for direct comparison with established performance standards. At each site data will be gathered over a five-year period to document wetland maturation.

The goal of this program is to provide vegetation and hydrology data, collected by volunteers, which will describe the extent and condition of state-created wetlands and their relative degree of success as measured against established performance standards for mitigation sites.

Data usage

Created wetland monitoring data will be used to:

1. Establish baseline conditions of created wetlands.
2. Monitor performance standards for five years.
3. Advise resource managers of remedial actions.
4. Aid in the review and revision of performance criteria and design guidelines for wetland mitigation projects.
5. Promote community stewardship of wetlands by training volunteers to monitor mitigation sites.
6. Fulfill state monitoring requirements.

7. Produce an annual report.

Vegetation monitoring

Methodologies and techniques for monitoring created wetlands performance in this program are based on the Interagency Mitigation Task Force (IMTF) guidance document drafted in August 1994. There are many methods of sampling and monitoring different aspects of the wetland biological community. Standardized sampling methods provide uniformity in site monitoring reports.

Vegetation, soils, and hydrology are the three physical indicators typically used in identifying wetlands. Vegetation density (which is one measure of biomass) and plant dominance are used to evaluate mitigation vegetation performance. Studies have shown that mitigation sites without sufficient plant biomass support low populations of fish and wildlife and provide insignificant water quality functions (i.e., nutrient removal, sediment deposition) (IMTF Guidance, 1994). The goal for created wetlands is to achieve 85% or greater wetland vegetative cover by the end of five years (COMAR, 1994).

What makes wetland plants so unique? They are plants adapted for life in water, or in periodically flooded or saturated soils (hydric soils) that are deficient in oxygen during some portion of the growing season (adapted from COE, EPA, and COMAR). Plants growing in wetlands may occur there either because they are adapted to the conditions of that habitat or because they are able to tolerate the wetland conditions.

Learning plant identification skills can be a fun and challenging endeavor. Plants we find in wetlands can sometimes be found in uplands. You might ask how can that be? Over time, plant populations adapt (through the process of natural selection) to the environmental conditions that affect them. If the conditions are too harsh the plants will not survive. When the plant population has had timeperhaps generationsto adapt to specific environmental conditions, certain physical characteristics of the plants may also change.

There are many factors that contribute to determining the location in which a plant occurs. For the field person monitoring created wetlands, the most important factor to bear in mind is that the plants that occur there have adapted themselves to soil that is inundated or saturated for extended periods of time during the growing season. A lack of hydrophytic vegetation can be an indication that the site is drier than the anticipated design criteria. The table at the bottom of this page lists 10 woody plants commonly used for wetlands creation in Maryland's coastal plain.

Monitoring principles

In designing methods to monitor wetland vegetation there are three important principles that must be recognized:

1. Keep methods simple.

2. Monitoring procedures are like a recipe and need to be followed.
3. The data you collect will only be as accurate as your confidence level in the method you apply

There is no mystery to acquiring the skill to take meaningful measurements in the field if you keep perspective on these principles.

How do we monitor vegetation?

Vegetation monitoring is used to establish plant density (quantity of plants per area) and dominant species (a plant species that exerts a controlling influence on the character of a community). Three techniques for gathering field data are utilized by this program: the transect line method, subjective analysis, and the six-foot-radius circular plot method.

The transect line

A transect is a line on the ground along which observations are made. The transect line has been used extensively in the biological monitoring of vegetation. This form of gathering field information is known as systematic sampling, by which items are selected at some regular interval along a traverse in a field study. This regular distribution of sample points may be used to produce a map along with statistical analysis.

In order to establish transect lines, first establish and stake out a longitudinal axis (baseline) running through the site and dividing it in half lengthwise. The baseline provides the foundation along which the transects are spaced. Transect lines are spaced parallel to each other and run perpendicular across the baseline through the monitoring site. The type of plant community will determine the type of sampling method used (i.e., circular plot or subjective analysis) along the transect line.

Subjective analysis

In our program, subjective analysis will be used in emergent sites to determine if plant stem density is equal to or greater than the performance standards. Subjective analysis is a visual assessment based on the field monitor's powers of observation. Observations are based on recognizing and noting a fact or occurrence that can be measured, but often is based on judgment. Time in the field greatly increases the observer's ability to distinguish plant types and vegetation density patterns.

The circular plot method

The circular plot method is used to calculate density for trees and shrubs. At intervals along the transect, six-foot-radius circular plots are established. The presence or absence of vegetation achieving the specified height of 10" or taller and growing within the circular plot is recorded. Plant identification and dominance are also recorded.

Circular plot vegetation density is computed by an interval system of measurement in which occurrences are counted and assigned weighted values. All tree and shrub counts are for living plants 10" or taller. Where there are no trees or shrubs the value is 0; if there is one living tree or shrub within the plot the value is 1; and if there are two or more living trees or shrubs within the plot the value is 2. These values are then used to calculate the vegetation density and cover types.

By recording observations made of plant type combined with measurements gathered from the transect line method, resource managers can determine if the created wetland meets anticipated performance standards.

Wetland plant sampling methods

I. **Emergent vegetation method** Equipment: Tape measure, 12" ruler, compass, 6' measuring stick, clipboard, and plant guide. The following steps explain how the transect line method is used in identifying two categories, "vegetated" and "open water," in emergent mitigation sites.

Step 1. The field monitor establishes a straight line (transect) across the area to be examined, perpendicular to the baseline. Transect #1 starts 20 feet from one of the longitudinal ends of the wetland. The transects are spaced parallel to each other at 50-foot intervals; each transect crosses the entire width of the wetland and is given a sequential number for identification.

Step 2. The monitor walks the transect line looking for living stems in a minimum density of 12" x 12" spacing (43,560 living stems per acre) along each transect. It takes some practice to be able to visually perceive what a 12" x 12" plant stem spacing pattern looks like. The following method is useful for beginners. With a 12" ruler in hand, start at one end of the transect line and proceed across the emergent zone, following the transect line, to the other side of the wetland. As you walk, measure the spacing of the plants with your ruler. The stems of the emergent vegetation should be 12" or closer together in order for the area to be considered "vegetated." When the spacing between plants becomes greater than the length of the ruler, stop and measure the distance along the transect you have walked. This marks the boundary of the area considered "vegetated." That distance will be recorded to the nearest 0.5 foot on a data sheet and transferred to the site plan. Where the density of plants is spaced further apart than the length of the ruler, the area is considered "open water."

II. **Scrub-shrub and forested vegetation method**
Equipment: Tape measure, 12" ruler, compass, 6' measuring stick, clipboard, and plant guide. The following method for measuring the success of woody plant colonization should be conducted once, between May and September, for each of the five growing seasons following the completion of construction of the wetland.

Step 1. Establish transects as described previously. The first transect is located 20 feet from one of the ends of the baseline. Thereafter the transects are spaced at intervals dependent on the size of the site. If the site is greater than 0.5 acres and less than 5 acres, the transect lines will be spaced 50 feet apart. If the site is greater than or equal to 5 acres, the transect lines will be spaced 75 feet apart.

Step 2. Six-foot-radius circular plots are spaced at 50-foot intervals along each transect. The presence or absence of living wetland trees and shrubs achieving the specified height standard (10 inches or greater) and growing within the circular plot is recorded. (Note: The first circular plot for the even-numbered transects is taken on the same side of the wetlandi.e., from the same cardinal direction. The first circular plot for the odd-numbered transects is taken on the opposite side of the wetland. For example: even numbers begin on south side of wetland site, therefore odd numbers begin on north side.)

Step 3. The numbered transects and circular plots are depicted on a map of the wetland mitigation site (scale 1 inch = 100 feet). Circular plot data is recorded on standardized data sheets. Record data using the interval system described above (i.e., 0 = no living tree or shrub over 10" in height, 1 = one living tree or shrub over 10" in height, 2 = two or more).
Monitoring hydrology

Hydrology is the science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rock, and in the atmosphere. We are interested in monitoring hydrology because it is considered the driving mechanism required for the formation and maintenance of wetlands. Fluctuations of water level and the duration of inundation or saturation determine, in part, the composition of plant communities.

Establishing wetland hydrologic conditions is essential for successful wetlands plant growth and hydric soil development. Before a plan is ever drafted, a lot of time and effort has gone into establishing the hydrologic sources for a wetland creation site, in order to assure adequate hydrologic input to the site.

Inundation at the surface can be easily observed and recorded on a map. There are times throughout the year, however, when site visits will not coincide with surface inundation, and when soils are saturated below the surface. Therefore, several shallow wells are commonly installed within a wetland to measure water levels below the surface to depths of 0.5 to 2.0 m, depending on the expected movement of the local water table. Plastic (PVC) pipes with narrow horizontal slots have been used successfully in numerous projects. These pipes can also be used to measure depths of surface water when standing water is present, or separate staff gauges can be installed.

I. **Monitoring hydrology: ground water** Equipment: 6' measuring staff, tape measure, clipboard, data sheets.

Step 1. Placement of groundwater wells: Hydrologic zones distinguished by a 2-foot change in elevation should have a minimum of one groundwater monitoring well installed. In addition, a hydrologic zone should have a minimum of 1 groundwater well per 4 acres. If a given hydrologic zone occupies a total of 5 acres, at least 2 groundwater wells should be installed. In emergent zones, wells are to be located in the driest area of that zone. Guidance for installation of groundwater monitoring wells has been prepared by the National Resource Conservation Service (NRCS).

Step 2. Collection of data: The collection of groundwater well data is initiated within 14 days of the start of the growing season and continues for the first two (full) consecutive growing seasons subsequent to the completion of grading. Groundwater well readings are taken once every 14 days for the first two months (60 days) of the growing season, and every 30 days for the remainder of the growing season. Groundwater well readings are recorded to the nearest one inch on data sheets.

II. **Monitoring hydrology: surface water**

If surface water is evident on the days the groundwater data is being collected, surface water measurements should be taken at the well. If no surface water is present, note that on the data sheet. The collection of surface water data for the most part will be limited to emergent zones and early season high water in scrub-shrub and forested zones. The following procedures apply to emergent zones.

Step 1. Surface water measurements: Water depth measurements are taken along the same transect lines that have been established to monitor vegetation. Surface water depth measurements are taken at 25-foot intervals along each numbered transect, using a 6-foot measuring pole that is marked in 1-inch increments. The bottom of the measuring pole is equipped with a flat 1-foot diameter mesh or plastic disc support, to prevent the pole from sinking into the wetland substrate (mud).

Step 2. Collection of data: Surface water depth measurements are recorded every 14 days throughout the first 2 months (60 days) of the growing season after the completion of grading and once every 30 days for the remainder of the growing season. The growing season can also be determined from climatological data given in most SCS county soil survey

CONCURRENT SESSION 4

Making Stewardship Measurable

Moderator: **Molly MacGregor,** Mississippi Headwaters Board
Speakers: **Joan Martin,** Huron River Watershed Council; **Joe Farrell,** University of Delaware Sea Grant; **Mary Ellen Wolfe,** Project Watercourse Joan Martin Huron River Watershed Council, 1100 N. Main St., Suite 210, Ann Arbor, MI 48104, 313/769-5917

Adding Stewardship to Volunteer Monitoring: Using the Data to Involve the Community

We have been monitoring the Huron River in southeastern Michigan for four years. All the steps in the project are done by volunteers, assisted by one full-time Director and one half-time Assistant. We measure many physical characteristics of the creeks, and we focus on the benthic macroinvertebrate population as the primary indicator of creek health. Our program is very similar to the EPA's Rapid Bioassessment III for habitat and population assessment. By sampling the benthic population twice a year and identifying the macroinvertebrates to family, we are able to measure the relative health of our 34 sites in the 900-square-mile river system.

Our program is continually evolving, directed by an Advisory Council (composed of volunteer monitors) and a Technical Advisory Committee (including scientists and agency directors). The number of volunteers and their efforts amounts to the equivalent of a full-time person working a lot of overtime each year. Our goals are to put together an accurate picture of the state of the river, as well as to provide an experiential education for the watershed residents who learn about the river system while they are measuring it. The result of our volunteer effort was summarized at our annual Creek Conference last March by an aquatic ecologist who said that we had compiled the best data set available on any river in Michigan.

The monitoring program has revealed subtle changes. For instance, while Fleming Creek still looks attractive, the benthic population is deteriorating, the channel is overwidening in several locations, and sediment is depositing downstream. The rural landscape of the Fleming Creek watershed is undergoing constant residential and commercial development. Now is the time that planning decisions must include creek protection.

The volunteer monitoring program seems successful. (We even have the first draft of a Quality Assurance Plan.) However, my fear is that we will be so focused on making our monitoring effort complete that we will accurately record the demise of our river. Therefore, once we had compiled the first two years of data into stream reports, we took the bad news to the community. One of the popular local creeks was in trouble. We asked the three townships in the Fleming "creekshed" to support a Fleming Creek Advisory

Council (FCAC) that would work to protect the creek. The response from the township Trustees was uniformly positive.

The three townships have provided funds for activities of the FCAC and passed a resolution that endorses the FCAC as an advisor to the Planning Commissions and the Trustees, and as an educator of the residents. The local newspaper wrote a major article about the FCAC, characterizing it as unusual for two reasons: local governments were cooperatively "tackling an environmental issue that crosses their political boundaries, and they were doing it preventively - before a problem develops" (Ann Arbor News, 5/29/94). Recently a developer requested advice from the FCAC on his site plan, before taking it to the Planning Commission.

What fostered this transition from monitoring to stewardship? Our Adopt-A-Stream Program began six years ago as a stewardship program. The staff member who originated the program worked very hard. He wrote a booklet on "Stream Stewardship," prepared handouts on needed stewardship behaviors, made signs that identified many of the creeks, and arranged for people to clean up the city creeks. Trash was removed, but no momentum was gained. There was no reliable evidence that could sound an alarm calling people to act with urgency.

In 1992 we began consistent monitoring. After some 200 people had measured, mapped, and studied the aquatic populations in many of the creeks, there was considerable and widespread interest in the state of the creeks. And, the volunteers had something to say. They initiated a variety of efforts, including presentations to the communities and articles in local newspapers. They made displays and a brochure about their creeks, which they took to local community meetings and fairs.

While the creek has not been saved, many people are concerned about it, and a system is in place to try to protect it. Meanwhile, the volunteer monitoring continues.

Joseph G. Farrell
Inland Bays Citizen Monitoring Program, University of Delaware Sea Grant, 700 Pilottown Road, Lewes, DE 19958, 302/645-4250

Linking Monitoring to the Community: Responding to Community Needs

The Inland Bays Citizen Monitoring Program was established in 1990 to collect verifiable water quality data to support public policy decisions regarding the management of Delaware's inland bays and to increase public participation and support for the protection and management of these resources. Nutrient overenrichment and habitat loss have been identified as the two critical problems facing the bays.

The Citizen Monitoring Program has been successful at forging partnerships with data users, most notably state and local governments. The data are included in the state 305(b) report, constitute an integrated component of the Inland Bays Monitoring Plan, and have

been used to support the opening of closed shellfish areas and the siting of submerged aquatic vegetation test plots. Citizen monitors have also planted clam beds and monitored the clams for growth and survival, to support the development of a shellfish management plan.

In the spring of 1995, the town council of a coastal resort community requested assistance in identifying water quality problems in the town's extensive canal system. The council planned to use the citizens' data to help in developing a stormwater management plan. The canal study that we conducted in the town of South Bethany was unique for us in that the request originated from the town council, and a town council member recruited volunteers and served as the local project coordinator.

We met with the town council and, based on their concerns, designed a sampling program to investigate (1) overall water quality and (2) effect of stormwater runoff. We then trained community members, conducted a 9-week sampling program at 13 sites, analyzed the data, and provided a report to the town council and community. The project results are being used as the basis for implementing stormwater management measures.

Measurable project benefits and accomplishments include:

1. Improved understanding of water quality dynamics led to a change in attitude by community members - from denial to collaborative problem solving.
2. Community had strong sense of ownership over study, which increased credibility of project results. Town council decided what questions needed to be addressed, assisted in the study design, recruited volunteers, and participated in the study.
3. The data collected were of known quality. The project design included a quality assurance plan. The results were evaluated statistically and were compared to other related studies.
4. Partnerships were formed between and among citizens, local government, county and state agencies, a university, and a nonprofit organization.
5. Project was supported by the community. Town council, homeowner's association, and county and state agencies offered financial or in-kind support.
6. Project laid the groundwork for Phase II intensive stormwater sampling (1996-97) and negotiation between state and local government on cost-sharing for infrastructure improvement.

Mary Ellen Wolfe
Montana Watercourse, 201 Culbertson Hall, Montana State University, Bozeman, MT 59717, 406/994-1910

Know Your Watershed, Montana-Style

In the February 1996 issue of National Geographic magazine, John G. Mitchell stated a powerful truth:

> Each one of us is a citizen of a watershed, wherever we may live. But none of us can break bad habits and mend behaviors enough to become part of our watershed's solutions until we understand how and why we are a part of its problems.

From my perspective, this statement articulates the concept of watershed citizenship. Mr. Mitchell suggests that a foundation of understanding must first exist before citizens become problem-solvers in their watersheds.

The philosophy of the Montana Watercourse, a statewide education program, has much in common with this statement. Our mission is to foster lifelong stewardship of the state's water resources by providing non-advocacy water resource education programs and materials. "Know Your Watershed" is the current focus of our Adult and Community education efforts, and it is making small steps forward to foster watershed citizenship in Montana.

The Know Your Watershed program

In 1994, increasing interest in local watershed management prompted the Montana Watercourse to develop a pilot Know Your Watershed project. With permission from the Conservation Technology Information Center (creator of the national Know Your Watershed program), Montana initiated a community-based, collaborative learning project to help citizens in three separate basins to better "know their watersheds."

The project involves development of a community workshop (and optional tour) which targets all citizens interested in learning more about the characteristics, operation, and management of their watershed.

The general goals of the workshop are:

1. To increase participants' knowledge and understanding of their watershed. What are the facts about water/land use, water quality, surface/groundwater supplies, etc.? How are these components interrelated?
2. To create an opportunity for public dialogue among all stakeholders and community members regarding the many demands and uses of the watershed.
3. To provide participants with information and resources on other watershed planning and management initiatives being used in Montana and the West.
4. To facilitate communication and collaboration among water resource "experts" and communities needing their expertise.

The workshops are commonly developed through a collaborative planning process within the watershed, facilitated by staff of the Montana Watercourse. For best results, a broad-based local committee is organized to plan the workshop. The group then develops a customized workshop agenda, highlighting priority educational needs and issues in the watershed. The Montana Watercourse provides assistance with organizational and educational aspects of the workshop.

The information presented at Know Your Watershed workshops varies because each workshop is planned to accommodate local educational needs and issues. However, most workshops address the following questions:

1. What are the physical, chemical, and biological characteristics of our watershed? (A field tour to explore different parts of the watershed is sometimes included.)
2. How is our watershed used? What issues have evolved from the multiple water uses within the basin? (This usually includes an overview of land and water use. In areas of rapid growth, discussion of trends is important.)
3. How is our watershed managed? What are the laws and regulations that guide water management within the watershed? ("Who does what and why?")
4. What role do citizens have in sustaining the health and productivity of our watershed? What role could and should they have?

These topics are usually addressed by speakers and presenters from the local area. Speakers have included scientists, local historians, ecologists, well-drillers, hydrologists, farmers, ranchers, municipal water and waste water supervisors, fishermen, outfitters, and others.

Planning a Know Your Watershed workshop Our experience with the Know Your Watershed pilot project (three workshops) and subsequent Know Your Watershed workshops has involved the following steps.

1. **Local contacts are made and the planning process initiated.** We have received requests for workshops from both individuals and groups (e.g., Conservation Districts, water user groups, citizen activist groups). We work with the initial sponsor to identify and invite a broad-based, representative group of stakeholders to attend the first Know Your Watershed planning meeting. These folks are commonly invited by means of personal phone calls, followed by a mailed reminder.
2. **An initial planning meeting is conducted.** The purpose of this meeting is to describe the goals of the Know Your Watershed program, brainstorm local educational needs, identify possible target audiences, and identify benefits or outcomes of watershed education. We have learned to always conclude this first meeting by asking two questions:
    - Is now the time for a Know Your Watershed educational event in this watershed?
    - If so, is this the appropriate group to plan it? Asking these questions gives the group a chance to examine themselves, to determine whether those present at the table are truly representative of stakeholders in the watershed. This is an important step! Before concluding, take time to brainstorm a new list of names to invite to the next meeting.
3. **Convene a second planning meeting.** At this meeting, we revisit the work that was accomplished at the first meeting. We allow time for new educational needs, target audiences, and workshop benefits and outcomes to be added to those identified at the first meeting. We discuss preferred formats, such as workshops,

tours, public forums, water festivals, etc., and begin building a content agenda. We usually provide a sample agenda as a starting point. Some groups prefer to undertake the more time-consuming task of custom-designing their agenda.

4. **Convene additional planning meetings as necessary.** We have accomplished the planning process in as few as two meetings and as many as ten. The tasks to be accomplished generally include:
    - finalizing the format of the educational event and the content agenda
    - identifying appropriate experts and stakeholders to make presentations
    - identifying a correspondent to communicate and instruct presenters
    - identifying desired maps and factual information to include in the workshop packets
    - establishing subcommittees, if necessary
    - brainstorming financial sponsors
    - discussing brochure development, public relations, and promotion of the event
    - identifying local planning committee persons to make initial contacts with speakers and potential sponsors
    - discussing logistical arrangements
    - developing an evaluation form to assess the workshop strengths and weaknesses
    - filling out a Task Timeline to divide the labor and set deadlines
5. **Conduct the Know Your Watershed event (workshop, public forum, tour, etc.) as planned.** Attention to the tasks listed above will assure that on the day of the event, things will move smoothly to a successful conclusion. Be sure to include an evaluation form in the information packets that each workshop participant receives.
6. **Conduct a follow-up evaluation meeting.** This can be an informal gathering at which the workshop evaluations are shared. We have generally revisited our goals and discussed how we met or fell short of realizing them. This is also a good time to discuss next steps or additional educational needs, as a preface to future events or a "specialized" Know Your Watershed workshop.

Lessons from Know Your Watershed

Lesson #1: There is a need for and interest in community-based watershed education developed through a collaborative local planning process. Since the end of the pilot project in January of 1995, we have responded to requests from seven additional watersheds for assistance in planning Know Your Watershed workshops. The local planning group bears the burden of soliciting funding to make the event happen, and they have successfully done so, with assistance from the Montana Watercourse.

Lesson #2: It is critical to involve a representative group of local stakeholders in the planning process, in order for the workshop to be well attended and deemed credible and legitimate in the eyes of all of the stakeholders. It is also valuable for the project coordinator/facilitator to communicate directly, as much as possible, with each member of the planning team. This helps assure each member that their contribution is critical to

the workshop's success, and encourages their continued interest and participation, should the planning process be somewhat prolonged.

Lesson #3: To the degree that there is local willingness and interest, the facilitator should be ready to turn the "reins" of the local planning process over to the local planning/steering committee. It is important for the effort to be owned by those who plan it and invest time and effort in making it happen. In one watershed we worked with, this planning group became the "embryo" from which a watershed council sprouted.

Lesson #4: The facilitator (Montana Watercourse) views its role as that of a catalyst and a neutral, outside "servant." We have no long-term interest or organizational goal within the watersheds we serve. This has made it easy for people to share concerns with the facilitator about how the process was proceeding. It has also helped us to go into every basin with a blank slate, in terms of our own expectations of an outcome. It has helped assure that the process is driven by the local planning group and that the outcome is theirs.

Making stewardship measurable

What do Montana's Know Your Watershed experiences suggest to volunteer monitors interested in our workshop theme of "making stewardship measurable"? Before addressing this question, it would be useful to clarify what we are talking about when we refer to "stewardship" and "measurable." First, what is stewardship? Stewardship may be defined as "the exercise of responsible care over possessions entrusted to a steward."

Second, what is a measure of stewardship? Definitions of "measure" vary considerably. I was struck by two: (1) a standard by which something intangible is determined or regulated; and (2) a directly observable quantity from which the value of another related quantity may be obtained. Together these two definitions seem to cover a broad spectrum of possible measurables: both intangibles and objects that can be quantified. I believe volunteer monitors should continually keep both definitions in mind. Why? Because though the volunteer monitor may be making real-world observations of chemical and biological conditions (i.e., the "quantifiables"), important "intangibles," like negative public attitudes regarding volunteer monitoring activities, can affect decision making. This can, in turn, negatively impact volunteer monitoring activities.

Having said this, and keeping in mind the definition of stewardship ("the exercise of responsible care over possessions entrusted to us"), I'd like to make several concluding observations, based on our experience in Montana, to volunteer monitors committed to making stewardship measurable.

1. If you consider your efforts to be "stewardship" and hope that others in your watersheds will do likewise, it is essential to openly communicate with all stakeholders in your communities about the work you are doing. One-way communication, such as press releases and newsletters, is great, but open public

dialogue, such as that afforded by our Know Your Watershed workshops, is even better.

Our experience has taught us that Montanans are interested in and concerned about "credible monitoring." They want to know who is monitoring, where, and why. They want to know who trained the monitors, what qualifies them to be doing it. They want to know what the monitoring project's goals are and how the information gathered will be used. In Montana, where the dominant political cultural tradition for many generations has been "That government is best which governs least," many long-time residents are fearful that volunteer monitoring is merely a tool for gathering negative evidence that will eventually be shared with state water quality officials who may use it to indict a specific landowner or water user. They are fearful that volunteer monitoring may epitomize the opposite of their idea of stewardship, by not being accomplished "responsibly." So I suggest, again, that you openly and regularly create opportunities for public education and dialogue, to let your watershed neighbors know about the work you are doing, and to get them involved. Know Your Watershed events have provided friendly forums where those with questions about volunteer monitoring can hear answers from those directly involved. One possible outcome of such communication may be to turn skeptics (or even opponents) into volunteers!

2. Consider planning an open public forum within your watershed where volunteers and technical advisors or scientific experts can describe and interpret your monitoring results to the interested public. The Know Your Watershed model of a locally driven collaborative planning process might be one way to report your monitoring results within the context of specific community concerns. One side benefit might be that you'd create an opportunity for local decision makers to hear from monitors, technical experts, and the concerned public, and vice versa. Such exchanges can be valuable to all the parties involved.
3. As stewards compiling measurable information within your watershed, you have a responsibility to see your volunteer monitoring efforts for the potentially powerful tool that they can be: a community-based device to help raise awareness regarding the health and status of local watershed resources. If volunteer monitors do nothing more than collect data, much of their potential import and usefulness lies untapped. But like any powerful tool, monitoring data must be used with care and respect. When you share your information with others, do so in a manner that does not suggest disrespect. Try to avoid thinking yourselves the "only" responsible stewards who are active in your watershed. Know Your Watershed workshops provide a forum for information exchanges to take place in a field that puts all local success stories on an equal footing.
4. Citizens are interested in how volunteer monitoring data is used. A public forum, such as a Know Your Watershed workshop, is one venue where the relationship between local monitoring activity and government decision-making entities can be described and discussed openly. Consider staging a discussion between the volunteers, agency representatives, and concerned local citizens to set the record straight and address citizen concerns head-on.

Summation

Know Your Watershed educational events are an opportunity to demonstrate how and why monitoring is stewardship, and better yet, stewardship made measurable! Know Your Watershed events provide an opportunity to learn the facts about a watershed, to share diverse perspectives, and to clarify issues of concern. They also present an opportunity for the discussion of values. The forums can be relatively simple, low-cost events that spread the word about positive stewardship already occurring within a watershed and describe options for future stewardship.

Restoring Wetland and Lake Habitats

Moderator: **Christy Williams,** Izaak Walton League of America
Speakers: **Esther Lev,** The Wetlands Conservancy; Louis Smith, Smith Parker; and **Dale Claridge,** Wenck Associates

Esther Lev
The Wetlands Conservancy, P.O. Box 1195, Tualatin, OR 97062, 503/239-4065

"Wetland Restoration: Steps to Success" - A Video on Wetland Restoration

The Wetlands Conservancy, a small nonprofit land trust in Portland, Oregon, has created a video titled "Wetland Restoration: Steps to Success." The 21-minute video, funded by a grant from the U.S. Environmental Protection Agency, was directed and produced by The Wetlands Conservancy, Policy Initiative Group and Ibex Communications. Mark Griswold Wilson and Ralph Thomas Rogers provided guidance and technical review.

The video is the first piece in what is intended to be a series of videos and written handouts on specific techniques and suggestions on how to have the best success with wetland restoration projects. This first video is general in nature, identifying the major steps and issues to be aware of prior to design and implementation of a restoration project. Topics include site assessment, project planning and timelines, plant selection, the importance of using native plant species, when to plant, plant collection and ethics, and animal-proofing of plants. In addition, the video presents case histories of ongoing projects at The Wetland Conservancy's Pascuzzi Pond, a freshwater palustrine wetland located in Tualatin, Oregon, and the Salmon River estuary, on the Oregon Coast near Lincoln City.

The video has been made available to groups and individuals. In addition, The Wetland Conservancy staff has shown the video to seven groups, ranging from citizen watershed groups to teachers, a college-level restoration ecology class, and professional watershed managers. At each viewing, the group was given a brief history about The Wetlands Conservancy and the intent of the video project and then asked to give comments and critiques of the video's contents and presentation. In addition, groups and individual were asked to identify topics discussed in the video that they would like more detailed

information about in the form of handouts or subsequent videos. Approximately 125 people have viewed the video.

The Wetland Conservancy staff prioritized the list of requests and produced a brochure and four handouts on wetlands restoration techniques, with funds generated from the City of Portland Bureau of Environmental Services Community Stewardship Grants Program. The materials will be distributed to the groups that viewed the video, and any other stream groups, individuals, or schools who would like them. Materials will also be distributed by The Wetlands Conservancy, Portland Audubon Society, Bureau of Environmental Services Community Stewardship Program and

Oregon Department of Environmental Quality. As funds become available we will continue to create more handouts in partnership with other nonprofits, citizen groups, and local and state government agencies. We feel that the combination of the video and written materials will assist citizens, school programs, and groups to design, install, and maintain successful wetland restoration projects.

The video, brochure, and handouts are available from The Wetlands Conservancy at the address listed above. The video costs $20 ($15 for Wetlands Conservancy members), plus shipping and handling. The brochure and handouts are free of charge. The four handouts currently available are: "Vegetative Cuttings," "Container Plants," "Bare Root Planting," and "Protecting Your Wetland from Beaver and Nutria."

Louis N. Smith
Smith Parker, P.L.L.P., 808 Colwell Building, 123 North Third Street, Minneapolis, MN 55401, 612/344-1400, admin@smithparker.com

Dale Claridge
Wenck Associates, Inc., 1800 Pioneer Creek Center, Maple Plain, MN 55359, 612/479-4200

A Watershed Approach to Lake Restoration

Water knows no political boundaries. As public concern grows over the decline in the water quality in our lakes and rivers, one comprehensive approach to restoring water quality lies with an idea adopted by the Minnesota Legislature over four decades ago in 1955: watershed districts. This article reviews how watershed districts can provide critical tools for restoration of water resources, and presents some key considerations in adopting an effective "watershed approach" to lake restoration and management.

Watershed districts: background and purpose

The State of Minnesota has been a pioneer in the concept of watershed-based water management, adopting the Minnesota Watershed District Act in 1955. The Minnesota Watershed District Act provides for the establishment of watershed districts "to conserve the natural resources of the state by land use planning, flood control, and other

conservation projects . . . using sound scientific principles for the protection of the public health and welfare and provident use of the natural resources."

The Minnesota Watershed District Act recognizes several fundamental concepts in the effective management of water resources. First, the law recognizes that water does not adhere to political boundaries and, thus, allows for the establishment of watershed districts as local government units bounded by hydrologic divides as opposed to political borders. As a result, water bodies and the land draining into them are regulated by one local entity with a central comprehensive vision for managing the entire water resource.

Second, the law recognizes that regulation of land use within a watershed is an essential component in protecting and preserving the water resources within the watershed. Again, watershed districts, as local entities with boards made up of local citizens, provide an effective tool in regulating land use and protecting water resources. As Michael Parfit wrote in the November 1993 issue of *The National Geographic:*

> The intimacy of the smallest watersheds may be a key to their restoration: At that level every individual can have an effect. "It's almost impossible to address water quality on the main stem of a river," says James Fisher of the National Watershed Coalition. "If you do it one small watershed at a time, you still have public support. Small size is the advantage. This replaces Big Brother with Joe down the creek."

As an example, the Minnehaha Creek Watershed District (MCWD) was established in 1967 to protect the water resources of the Minnehaha Creek watershed. The Minnehaha Creek Watershed District is approximately 181 square miles and includes all or part of 27 cities, three townships, and two counties. Through its extensive monitoring and analysis of the watershed, the MCWD identifies the root causes of water quality degradation and flooding, and uses this knowledge to develop and implement solutions that address these causes. The MCWD's approach includes both nonstructural solutions, such as public information and education and regulation of land and water use, and structural solutions, including comprehensive lake restoration projects, various hydraulic improvements addressing flooding, and a headwaters outlet control structure.

Lake improvement techniques

A. ***Structural improvements:***
Wetland restoration/wet detention basins

In many watersheds, phosphorus is the nutrient that poses the greatest threat to water quality by stimulating the growth of algae and aquatic plants. Phosphorus enters stormwater along with runoff from lawns and farm fields treated with fertilizer, from animal waste, and from other sources. Natural or constructed wetland systems present the most significant opportunity to remove phosphorus before it reaches a lake. Constructed wetland systems take advantage of the filtering and cleansing abilities of natural wetlands, and can be specifically

designed to treat urban stormwater. More than 150 of these systems are now in operation throughout the United States, and most of these projects have been built since 1988.

Depending upon their particular design, these stormwater wetlands can vary significantly in their effectiveness in removing phosphorus and other nutrients. Given this wide variation in effectiveness, it is imperative to design the wetlands based upon a thorough investigation of the hydrology of the subwatershed involved.

Wetland treatment systems have a number of advantages over other treatment methods. They are comparatively less expensive to construct, costing as little as one-fifth of the cost of treating a similar amount of wastewater with a traditional system. Wetland systems are typically designed for gravity flow, so they are more energy-efficient than mechanical treatment systems. While constructed wetlands require ongoing operation and maintenance expenses not normally associated with natural wetlands, as passive treatment systems they require much less operation and maintenance expenditures than do traditional treatment systems. Typical maintenance tasks involve sediment removal, monitoring, and vegetation management. As an added benefit, constructed wetlands can provide many of the same wildlife habitat and other benefits as natural wetlands. When carefully designed, constructed wetlands can be a highly cost-effective means of removing phosphorus from stormwater while providing an attractive amenity to the neighboring community.

B. **Nonstructural best management practices**

1. ***Lawn and garden management.*** Runoff from lawns and gardens is often a source of pollutant loadings. Efforts directed at lawn care practices can be effective in reducing pollutant loadings. Such efforts include banning the sale and/or application of phosphorus-containing fertilizers, regulating the sale and/or application of herbicides and pesticides, licensing and regulation of lawn care companies, encouraging or requiring alternative ground cover, and promoting proper disposal of yard waste.
2. ***Animal waste/livestock management.*** Nutrient loading and bacteria from animal waste may be a source of pollutant loadings into water bodies. The sources of animal wastes may be extremely varied, ranging from large-scale horse or hog farms and feedlots, to large resident waterfowl populations, to domestic pet wastes. Depending upon the source of the animal waste, the following practices may assist in the reduction of pollutant loadings from this source: (1) use of zoning to place animal facilities away from sensitive water bodies; (2) reduction in resident waterfowl populations through relocation or destruction; (3) frequent removal of animal wastes from parks and open spaces; and (4) public education concerning the deleterious effects of poor animal waste management.

3. ***Erosion and sedimentation control.*** Erosion produces sediment, which carries nutrients, interferes with the working of well drainage systems, and can, over time, decrease the depth of a water body. Sediment being washed into drainage systems and water bodies may contain not only soil particles and organic material, but also high levels of heavy metals, nutrients, and agricultural chemicals. Thus, implementation of erosion and sedimentation control measures can greatly reduce nutrient and pollutant loadings. Best management practices may include on-site sediment control during and after construction activities; encouraging property owners to keep areas abutting drainage systems and water bodies vegetated; and street sweeping to remove accumulated sediment.

Public education

Public information and education programs can be effective tools for changing behaviors that have detrimental effects on water quality and encouraging stewardship of water resources. Public information and education may also reduce the future need for structural improvements to correct the detrimental effects of harmful activities.

Public education programs can focus on any number of negative impacts on the water, and can be conducted through a variety of mediums and directed at a variety of audiences. Examples of public education programs include:

- informing residents and businesses about proper methods for disposal of hazardous waste and yard waste, and minimum-impact automobile maintenance practices
- encouraging landowners, developers, and municipalities to use best management practices to control the detrimental effects of certain land use practices
- use of stenciling of curbs and drainage system openings, neighborhood presentations, public service announcements, and Earth Day events to distribute information

Intergovernmental cooperation

It is inevitable that any significant lake restoration project will find itself in the midst of potentially complex relationships between federal, state, and local governmental entities and private property owners. Some governmental agencies will provide a permitting and regulatory function, while others will contribute their financial and staff resources to different components of the project. It is vital that the contributing partners clarify their responsibilities to the project through a pre-implementation cooperative agreement.

These agreements should outline general responsibilities and performance guidelines for the project. Often, it will be necessary to provide an organizational

structure to the project so that each party's participation is assured and communication between the parties is facilitated. Large multi-year projects with a variety of participating agencies should have some form of coordinating board to provide general oversight and policy direction for the project. Similarly, a cooperative agreement should provide for a technical committee so that design and permitting issues are thoroughly discussed among the participating agencies. Agreements that clarify how the project will be communicated to the public, and who will have the responsibility for these communications, are also helpful.

There is a very fine line between too much and too little structure to these multi-party relationships. The scope and duration of a project, as well as the number of participating parties, will determine in each case how much structure will be useful.

Citizen involvement

Citizen involvement is an important component in both planning and executing a lake restoration project. Citizens can be directly involved in planning a project through creation of a citizens advisory committee. This committee can be made up of any number of individuals representing various organizations, neighborhoods, and special interest groups. The committee can suggest goals for the project and assist in the selection of actions to be taken. Public involve- ment and input can also be achieved through public hearings and neighborhood meetings.

Government permitting and approval

Almost every lake restoration project, whether it involves dredging, the use of alum, or the construction of wet detention basins or wetlands, requires some type of governmental permit or approval. Although the types of permits needed depend upon the project, there are certain general permitting principles that should guide the permitting process for any project.

First, prior to approval of the project, the entity constructing the project should determine exactly what permits and approvals are needed and from which governmental agencies. This determination is critical because the types of permits needed may affect both the design and the feasibility of the project.

A second guiding principle in obtaining permits is working with the permitting agencies in advance of submitting permit applications. Agency personnel are a valuable resource in the design of projects. Consulting them in advance may lead not only to a project that can be permitted but also to a more effective project. Working with the permitting agencies in advance will also speed the permitting process once a permit application is submitted because the agency is already familiar with the project.

A third guiding principle is timing. Permits must be applied for so that they can be obtained in advance of the anticipated start date of the project. While this may seem obvious, agencies receive many requests for a last-minute permit that an applicant did not realize was necessary. Almost all permits have public notice requirements that cannot be waived or altered. In addition, agency workload may prohibit agency personnel from acting on a permit application as quickly as the permit applicant desires.

Conclusion

As nonpoint source pollution of our lakes and rivers continues to be a compelling public concern, the watershed approach is a comprehensive, effective way to restore water quality. Watershed districts in Minnesota have been involved in the local management of water resources for decades. As a local unit of government defined in hydrological, rather than political, terms, watershed districts are in a position to restore our water resources "one small watershed at a time."

Dealing with Your Data, Part 2: Know Your Audience, Tailor Your Message

Moderator: **Jerry Schoen,** MA Water Watch Partnership
Presenters: **Jerry Schoen,** MA Water Watch Partnership; **William Deutsch,** Auburn University Department of Fisheries; **Steven Hubbell,** Lower Colorado River Authority

Jerry Schoen
Massachusetts Water Watch Partnership, Blaisdell House, University of Massachusetts, Amherst, MA 01003, 413/545-5532

Data Presentation Strategies

"Dealing with Your Data, Part 1" (Session 3) discussed what it takes to produce basic data presentation tools, or ingredients (e.g., graphs, maps, slides, charts, tables, text, written reports). In this session, we talk about using the tools to make effective presentations to different audiences.

The purpose of any monitoring program is not to generate data, but to generate solutions to environmental problems. Data sets are only tools. You need to decide if you want to be a tool maker or a world changer. True, we need to make the tools, but to change the world, or our watersheds, we must all use the tools we make.

For instance: If your data use plan consists of writing a report and handing it over to an agency, consider that the agency personnel may not have the time, interest, or mandate to review or use your data. Or their idea of how to use your data may

be quite different from yours, leaving you dissatisfied with the degree and kind of action that results from sharing your sampling results with them. The most important message you can get from this session is to DO IT YOURSELF. Take ownership of your own data, and use it yourself to achieve your watershed protection goals. Don't rely solely on others. In our experience, data use is the least successful aspect of most citizen monitoring programs. (I am not talking about telling the story of your program; I'm talking about disseminating the actual results of your surveys.)

Here are a few ideas on how to get your data out to target decision makers:

7. Consider your audience, or data users - from farmers to agency scientists to the general public. Consider their characteristics - knowledge of the issues, level of technical expertise, viewpoints, amount of time they have to look at your data, etc. (See table on page 53 for some typical data users and uses.)
8. Consider the pitch: What you want them to do.
9. Consider your repertoire of data presentation tools (graphs, slides, speakers, etc.), and the characteristics of each: user friendliness, motivational content, "quick grasp" vs. "slow read," etc.

Use common sense to mix and match your audience, pitch, and repertoire to communicate the important information you have to the appropriate audience, to get the desired response. Stated another way, you're involved in a three-part process:

10. Produce your basic ingredients: graphs, maps, tables, and other props. Make them flexible; to the extent possible, make them interesting and comprehensible to both the expert and the general viewer. And, whenever possible, produce them in multiple formats. For example, say you produce a map. It's a relatively simple matter these days to use computer software and your own or commercial copying or graphics production services to generate it (a) on letter-size paper; (b) enlarged, to use in a poster; (c) as an overhead transparency; (d) as a slide; and (e) as a computer file. These multiple format reproductions will make it easy for you to make your pitch at a dinner talk, in a report, at an environmental fair, or at other places.
11. Assemble, or package, your ingredients into a pitch. Here's where you start to spread your message. You are going beyond pure data representation. You are establishing context for your data, which is essential if you want people to learn from it or act on it. A dissolved oxygen reading of 3.2 parts per million means nothing until your audience understands that the fish won't live at this level. It means even more if you can show them that the level dropped from 9 parts per million to 3.2 after a pollution event on a particular day. Sometimes, the numbers can actually get in the way. Busy tables full of numerical values of different parameters at different sites and dates can easily obscure the 3.2 DO reading.

Highlighting it with accompanying photos, maps, etc., will actually provide more information, even if you have to report less data.

12. Delivery. Data and pizza have one thing in common - people want them delivered. You have to go to your audiences to get their attention. The venues at which your ingredients are shown and your pitch is made are an important consideration. These can range from storefront windows where posters are displayed, to Lions Club dinners where you give a slide show, to newspapers, public meetings, skywriting, etc.

Pay attention to all three elements of a data presentation campaign. Make sure they are compatible with one another.

Data presentation examples

The Green River Watershed Preservation Alliance (GRWPA) in northwestern Massachusetts is a small, all-volunteer group. They have produced a report, like most groups do. But they also put together a very low-tech poster that they used to good effect in river festivals and in downtown storefront displays. Some points about their poster:

- It's hand drawn. The base map was traced from a pasted-together blow-up of a road atlas. Major roads and a few key resources (e.g., a town beach) and pollution discharge points (e.g., urban areas, wastewater treatment plant) are drawn in. Using colored dots, the map indicates good, fair, or poor levels of bacteria and macroinvertebrate community health at several sites along the river. The look is simple and informal - which fits with the venues, where passersby will spend only a few seconds looking at the map. The intended audience is the general public. The message is quite basic: "Here's a rudimentary look at the health of our river."
- By placing the colored dots on wide strips of transparent tape, GRWPA can easily update the map for subsequent sample events. All they have to do is peel off the old dots and replace with new ones if the values change.

Another small, all-volunteer Massachusetts group, the Eagleville Pond Association, mixed some hi-tech graphics with some old-fashioned persuasion to request an "order of conditions" requiring a local farmer to reduce nutrient pollution. Their data showed high nitrate levels flowing from the farm to the lake via a tributary stream. They anticipated a hard sell with the local conservation commission (the farmer's wife is on the commission) and wanted to make a good pitch. With few resources of their own, they got help just by asking for it. They made a number of calls and found resources at the nearby University of Massachusetts (use of GIS hardware and software, student interns willing to do the digitizing and map generation, and some custom report- and graph-production donated by the Water Watch Partnership). With this help, the association had in their possession a GIS map of their lake and surrounding watershed, showing sampling sites in proximity to the farm and other land uses. They also had a set of

computer-generated color graphs of nutrient levels at key locations. They prepared for expected challenges to the quality of their work by securing some supporting documentation of their results (and of their interpretation of the results) from the university and from a private laboratory. They stated their concerns, illustrating their points with these props, and they got the order of conditions they sought.

(Note: Table adapted from the "Volunteer Environmental Monitoring Network Study Design" guidance document, prepared by the Merrimack River Watershed Council.)

Neither the GRWPA nor the Eagleville Pond folks are rich in know-how, money, or fancy equipment. Yet both made effective data presentations - one by using old-fashioned tools like tracing paper and pencils, the other by securing assistance from those with advanced technical resources.

Another, somewhat larger organization, the Charles River Watershed Association (CRWA), with a membership of over 1,000 and a staff of 4 to 6, used GIS and Corel Draw software to produce some simple but powerful graphical representations of significant problems in their watershed. A series of three maps of the watershed shows that the river's quality changes under different weather conditions. In dry weather, most of the river system meets swimmable-fishable standards for bacteria. Under moderate storm conditions, a significant portion of the river exceeds bacteria standards at least part of the time, and in heavy storm conditions, virtually the entire river exceeds standards all the time. By showing the affected river reaches in blue, purple and red (good to bad), CRWA's maps caused jaws to drop at EPA, in schools, and at town meetings throughout the watershed. CRWA used the same images in different formats: paper, slides, photos, overheads (whichever worked best for a given venue), and have gotten technical and lay audiences alike worked up over the situation.

The Kentucky Water Watch (KWW) program relies heavily on public forums to educate community members and stimulate action about water quality conditions. Here's how the forums are produced: After about a year of data collection, KWW head Ken Cooke asks the group if they want to conduct a "Clean Water Forum." If the answer is yes, Ken suggests a list of the kinds of folks who ought to be at the meeting - stakeholders such as SWCD board reps, University faculty members, planning and zoning commission members, public health experts, local industry groups, farmers, and civic and environmental groups. The group gets seven or eight of these stakeholders to agree to be panelists. In advance of the meeting, panelists are sent a copy of the group's data report.

The public is invited to these meetings. Some school meetings will have as many as 500 in the audience, although it works better with about 40 people. A moderator, usually someone from the sponsoring organization, introduces the panel. (Hint from Ken: Don't let the panelists talk about their programs! They'll go on too long.) The local group starts with a data presentation, using whatever charts, graphs, computer graphics they have. The moderator will then pose a

series of questions to the group representative and other panelists, asking what they think the data mean and what solutions there might be to any problems discovered. After this round, questions are opened up to the audience. Sometimes the media are invited, sometimes not, but generally they are welcome to attend. These meetings can be broadcast on local public-access cable TV.

The whole forum runs about 90 minutes to 2 hours. It doesn't take a lot of work to set it up. Ken spends 3 or 4 hours helping the local group, which will put in about 15 to 20 hours.

One of the main benefits of these forums is that they bring together officials and interested parties from all sides of the issue - health, zoning and planning departments, soil conservationists, sewer operators, etc. - people who, according to Ken, rarely seem to communicate on these issues otherwise. Also, by sticking to an open-ended format - letting the panel and the audience do much or all of the speculating - the sponsors are often able to get the local community to generate suggestions for solutions. After all, most of us appreciate and listen to our own bright ideas better than we do those of others!

Bill Deutsch
Alabama Water Watch, Department of Fisheries, 203 Swingle Hall, Auburn University, AL 36849, 334/844-9119, wdeutsch@ag.auburn.edu

Presentation Strategies for Different Audiences

This presentation will compare and contrast how citizen water quality monitors in the rural Philippines and Alabama use their data to produce positive change. Four types of "audiences" will be briefly presented (two from each country), with monitors' strategies for (a) creating ingredients, (b) packaging their presentation, and (c) delivering their message. Some questions to think about: Are the audiences of these places really that different? Which citizen group presently has the greater opportunity for "making a difference" with their data? What are some "global lessons learned" that can help both groups, and perhaps your group?

Monitoring and data presentation in the Philippines

Citizen volunteer water quality monitors in the Philippines are primarily young men who have little or no technical training, but a strong interest in the environment and community service. The monitors regularly attempt to communicate their findings to the general public, including women's groups, teachers, students, a tribal group, and local government leaders. The parameters the community deemed most relevant to monitor were those that have direct applications to agriculture (soil loss and total suspended solids) and health (fecal coliforms in surface water and drinking water).

Data are most effectively presented to the general public in an "unprocessed" and visual form, such as bacterial plates with varying numbers and colors of colonies, or filters with varying amounts and colors of suspended solids. The monitoring group is slowly growing as diverse audiences within the community see the relevancy of water testing to their daily lives.

The Local and Provincial Governmental Units and the Department of Health in the Philippines are concerned with declining water quality and quantity for the general public. For this audience, water data are effectively presented in the form of simple graphs, correlated with population, health, and land use data, in addition to the visual means used in the community presentations. Governmental leaders are receptive to recommendations for restoration and conservation of aquatic resources after seeing evidence of degradation in visual displays and graphs. In that regard, monitors have a voice in the establishment of local ordinances and other means of environmental regulation. National policymakers are interested in a demonstration of data collection and quality, as well as the applicability of successful citizen monitoring programs as regional and national models of decentralized resource management.

Monitoring and data presentation in Alabama

In the Alabama Water Watch Program (AWW), about 30 active groups monitor 200 sites on 100 water bodies statewide. The monitors and other interested citizens are kept informed about the program and general issues of water quality by means of two semiannual newsletters, "Alabama Water Watch" and "Nonpoint Source." Citizen data are presented in summary graphs, along with some interpretations of trends and questions to prompt dialog, in a "WQ" bulletin (published about four times per year). Two new positions (Volunteer Monitor Coordinator and Teacher Coordinator) were recently created in AWW to present citizen data to monitors, community leaders, and teachers in a more systematic and personal fashion. The AWW program remains primarily composed of white, middle class citizens, and special efforts beyond those presently used are needed to reach other audiences (Native American, African-American, and rural poor).

Citizen data are regularly presented to the Alabama Department of Environmental Management in Quarterly and Phase Reports (also used for Alabama Department of Environmental Management's 305(b) Report to Congress), with detailed raw data, summary tables, and graphs. Results of side-by-side tests of citizen testing equipment versus Standard Methods chemistry are occasionally presented, along with Quality Assurance protocols, to convey the credibility of citizen data. Several monitors meet quarterly as a Citizen Advisory Council to Branch Chiefs of the ADEM Water Division. Data summaries and citizen concerns and recommendations are presented to this audience. Contacts of citizen monitors with representatives of the Alabama Legislature has only begun, but a State Senator recently was the keynote speaker at the AWW Association Annual Meeting. Strong turnouts of citizens to such meetings, along with good press

coverage, may be the best form of "data presentation" for audiences of elected officials, who may otherwise be hesitant to address environmental issues.

Steven Hubbell
Colorado River Watch Network, P.O. Box 220, Mail Stop H219, Austin, TX 78767-0220, 512/473-3333, ex. 2403

Taking It to the Street:

Going Public with Volunteer Data

The purposes of this presentation are (1) to summarize recent initiatives by one volunteer monitoring program to publicly use volunteer data and (2) to suggest some fundamental questions program coordinators should address if they elect to initiate similar projects. The project used as the case study in this report has been under way for five months; there are certainly issues which have yet to emerge. The questions posed herein represent questions we had to answer to implement this project.

In March 1996, the Colorado River Watch Network (CRWN or River Watch) embarked on a new adventure in data use. The Lower Colorado River Authority (LCRA), which manages the CRWN program, hosted a series of public meetings throughout the organization's service area to provide a forum for communities to share their water-related concerns. One recurrent sentiment that emerged was the public's desire to receive timely information about the quality of the river in their communities. In response to this request, the LCRA decided to provide a monthly water quality index report through news outlets in riverside communities. The River Watch program was asked to provide monthly data reports to staff scientists to supplement the data gathered by staff monitors (who typically monitor every other month). The combined results are used to generate a series of monthly water quality indexes for 14 communities along the river and its major tributaries. Having grown into a solid monitoring network with over 50 active monitoring sites since its inception in 1988, CRWN enthusiastically accepted the challenge. In addition to the obvious benefits of bringing public attention to local waterways and establishing a forum for communicating environmental concepts, CRWN sees the project as an opportunity to publicly acknowledge the effort volunteers expend to gather useful water quality information. It also represents a giant leap forward in coordinating efforts between aquatic scientists and trained volunteers.

The indexes are generated using algorithms developed by LCRA scientists to rank the water quality in each of the site areas as "Excellent," "Good," "Fair," or "Poor." Six water quality indicators are used in the index: total dissolved solids, nitrates, orthophosphates, temperature, dissolved oxygen, and fecal coliform. Data from LCRA scientists are used in conjunction with CRWN data to create the monthly indexes, which are then provided to news organizations in the 14 communities. Since staff scientists monitor every other month, while CRWN

volunteers monitor an average of twice a month, the much-touted "frequency of data collection" benefit of volunteer monitoring is a vital asset for these monthly reports. Local publication of the indexes has steadily increased since the project began. Response to this initiative by volunteers and the general public has been positive.

Following are the questions that were addressed in developing LCRA's monthly water quality indexes:

15. What are our objectives? (Examples: respond to public requests, acknowledge volunteer efforts, inform public of current environmental conditions, contribute to general environmental understanding/awareness, publicize opportunities for involvement.)
16. Who is our audience? (Examples: the general public, schools, monitors, environmental agencies, the scientific community, governing bodies.)
17. What data-reporting approach can our program structure support?
    a. How frequently are data collected?
    b. How consistently are data reported?
    c. How many sites are monitored?
    d. How reliable are the data (are we confident of the level of quality assurance)?
    e. Will volunteer data be used exclusively, or will they be merged with other sources?
18. What will the final product look like (approximate length, focus, and design)?
19. What media will we use to distribute the indexes? (Examples: newsletter, newspapers, radio, television news, public service announcements, weekly publications.)
20. How frequently will we produce the report? (To answer this, consider objectives, distribution media, data availability, and staff resources.)
21. Who will perform the production tasks?
    a. Who will coordinate production?
    b. Who will determine the statistical method?
    c. Who will perform data entry and quality assurance checks?
    d. Who will coordinate volunteer data reporting?
    e. Who will produce graphics, layout, and text?
    f. Who will serve as liaison with news media?

Once these questions have been answered, a foundation should be in place to implement the data-reporting project. Inform volunteer monitors of your intentions, including project objectives and reporting schedule.

To encourage news organizations to carry the information, make it brief, informative, and locally relevant. For print media, make it visually interesting as well. We discussed such ideas as happy fish vs. sad fish, an indicator such as the gasoline level indicator in a car, a map of the watershed, and others before finally

selecting a simple rectangle divided into four sections with an arrow placed in the section representing the appropriate index rating (see illustration on preceding page). Crediting the volunteer group(s) that collected the data is a strong local selling point, as is invoking community spirit. Finally, if there is hesitation by the media to disseminate the information, try different avenues (radio instead of television, weekly instead of daily newspaper), ask volunteers to request the information from local news media, and persist in production.

As the public begins to see the results of water quality data collected by local monitors, a general appreciation for the value of volunteer monitoring may begin to take root. With careful planning and quality assurance measures, clear delegation of responsibilities, straightforward communications, and persistence, volunteer data can be regularly shared with the public as timely, relevant, and useful information.

Developing a Watershed Monitoring Plan

Workshop Leaders: **Jeffrey Schloss,** University of New Hampshire Cooperative Extension, and Geoff Dates, River Watch Network

Geoff Dates
River Watch Network, 153 State St., Montpelier, VT 05602, 802/223-3840

Jeffrey Schloss

New Hampshire Lakes Lay Monitoring Program, University of New Hampshire Cooperative Extension, 55 College Road, 109 Pettee Hall, Durham, NH 03824, 603/862-3848

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.

A *watershed ecosystem* is a functioning interacting system composed of living organisms and their physical (including both land and water) and chemical environment.

Physical/chemical processes

The main physical and chemical processes at work in a watershed are geology, climate, light, temperature, water current, and nutrients. The fundamental physical process at work in a watershed is the cutting of stream channels and the carrying of materials downstream. This process is governed by the underlying geology of the watershed and driven by the climate (heat and freezing cycles, precipitation).

Geology determines the bathymetry of a lake, which in turn influences lake mixing properties and flushing rate. It also determines the gradient of a stream, which determines the current velocity. *Current velocity* helps determine the composition of the stream bottom (by sorting different particle sizes), which helps determine what can live there. The watershed geology may form deep canyons, which may shade the water for long periods of daylight hours. This limits light penetration. *Light penetration* is important in determining water temperature and photosynthesis, the energy that drives the whole biological system. Water *temperature* helps determine the water's dissolved oxygen content and governs the rate of many biological processes. Watershed geology also helps determine the nutrient and dissolved mineral content of the water. For example, limestone geology tends to contribute more dissolved nutrients and minerals to the water, providing essential materials for biological activity. Nutrients can enter the stream dissolved in runoff, attached to eroded soil particles, or in decomposing organic matter.

The net result of the physical processes is the foundation for the biological processes.

Biological processes

The fundamental biological process at work in the watershed is photosynthesis, the process by which plants convert sunlight into organic tissue. This process happens both in the water and on the land and provides food for a host of other types of organisms.

Plants that convert sunlight into food are known as *primary producers*. In the water they include algae, mosses, and rooted plants. On the land they include trees, mosses, grasses, shrubs, and trees. This plant material is a food source for *secondary producers*. In the stream, these include microscopic animals, invertebrates (such as insects, clams, crustaceans, and worms), and vertebrates such as fish.

Biological processes in streams

Food for stream organisms is produced both instream and out-of-stream. Instream sources include primary producers growing on the bottom and in the water column. This material is harvested by *grazers* and *filter feeding* organisms, such as aquatic insects. Out-of-stream sources include leaves and other plant and animal material that drops into the water. This is known as *coarse particulate organic matter* (CPOM). CPOM is immediately attacked by *decomposers, shredders, and gatherers,* which break down these large particles into fine *particulate organic matter* (FPOM). The FPOM is then carried downstream where it provides food for filtering organisms. Finally, the stream organisms which consume plant material are themselves food for *predators.*

The food sources and the organisms that feed on them tend to change upstream to downstream. In the headwaters, the food source is primarily out-of-stream CPOM from overhanging vegetation. Organisms that process CPOM dominate. This same overhanging vegetation limits instream production by preventing sunlight from reaching the water. As the stream widens, overhanging vegetation shades less of the stream, and benthic (on the bottom) instream production becomes more of a factor. Grazers and collectors become more prevalent. In larger rivers, neither overhanging vegetation nor benthic instream production is as much of a factor as FPOM carried from upstream and plankton and algae in the water column. Filtering organisms dominate here. So, how organisms are distributed in a stream is determined, in part, by the food source.

It's also determined by habitat types. These types include *riffles, runs,* and *pools.* These habitats are created by the physical processes described above. They form a gradient from fast-moving, shallow water with relatively large particles on the stream bottom (boulders and cobbles) in riffles, through slower deeper areas with smaller particles on the bottom (gravel and sand) in runs, to deep slow water with silt and mud bottoms in pools. Each of these provides different types of niches for different organisms - for example, cover for fish and attachment surfaces for aquatic insects. These occur along the upstream-downstream gradient according to the geology of the watershed, generally from larger bottom materials in the headwaters to fine particles in the lower reaches. Habitat diversity (and therefore biological diversity) tends to be highest in the mid reaches.

Biological processes in lakes

Food for lake organisms that inhabit shoreline areas bordered by riparian forest can be processed in a similar fashion as in streams, but lakes tend to be most similar to large rivers at the downstream end of the continuum. Primary production is limited by the depth of sunlight penetration, with rooted and emergent plants favored in the shallow waters or *littoral area* and planktonic algae being produced in the photic zone of the open waters. Thus the majority of lake production occurs from within. Filter-feeding organisms run the gamut from microscopic water fleas to fish like the alewife, which has gill rakers to collect the algae which are filtered through its gills.

Habitat types include the littoral zone, pelagic open waters, and the deeper bottom area or benthic zone, all dependent on depth. Habitat conditions are also defined by temperature stratification in deeper lakes where a warmer, homogeneous layer of water (epilimnion) is separated from a colder bottom layer of water (hypolimnion) by an area of rapid temperature decrease (metalimnion or thermocline). The rooted plants in the littoral areas of a lake offer attachment and protection for the smaller lake organisms, while the colder temperature or (sometimes) low oxygen level of the bottom water layer can offer refuge to organisms that can tolerate these conditions.

Often the nutrient phosphorus is in shortest supply, so the extent of productivity in a lake can be determined by the factors that supply phosphorus to the lake. These can include the physical character of the watershed (geology and climate), the landscape (which may have vegetation that can intercept nutrients before they reach the lake), land use and cover, and human impacts. For a given amount of phosphorus that may enter a lake, the productivity is in turn controlled by factors such as the extent of the photic zone and how long the water is retained by the lake before it is released (flushing rate). The shallower the lake and the longer the water is retained, the more productivity will occur.

Developing a watershed monitoring plan:
The process

Developing a watershed monitoring plan involves making a series of choices about your effort:

V. Define the watershed and scale
W. Determine why you're monitoring
X. Decide what indicators you'll monitor
Y. Determine your data quality requirements
Z. Decide what methods you'll use
AA. Decide where you'll monitor
BB. Decide when you'll monitor

Each of these steps is briefly described below.

CC. ***Define the watershed and scale***

Watershed truly is a relative term in that one watershed can have many nested subwatersheds. Whether you should be considering a small pond or first-order stream, or a large river basin, lake watershed, or estuary, will depend on your resources (time, money, staff, volunteers, and expertise), the concerns you need to address, your organizational perspective (Are you a watershed coalition? lake association? town commission? regional entity?) and objectives (screening, management, restoration, etc.).

Once chosen, the scale of your study will be an important consideration as you decide what, where, and when to monitor.

1. **Landscape-level scale**
   - Involves a large geographic area to allow for the assessment of cumulative impacts.
   - May involve determining the proportion of land cover types (e.g., riparian area, impervious surfaces).

- Emphasizes studying upland conditions of the watershed and the resulting water quality and/or quantity of a representative site or sites downstream.
- Generally involves multiple political units (states, counties, towns).
- Terrestrial keystone or integrating species monitoring (eagles, osprey, lynx, warblers, bluebird) favored over aquatic chemistry and biological sampling.
- Facilitated through use of Geographic Information Systems (GIS) and spatial analysis capabilities.

2. **High-order streams, lakes**
   - Geographic extent can be large, so cumulative impacts also assessed.
   - Magnitude of change in water quality at representative site can be low due to dilution, but duration of change will be longer due to longer residual time.
   - Changes detected are less likely to be influenced by ambient flows.
   - Loadings are more important than concentrations.
3. **Lower-order streams**
   - Smallest geographic area to cover.
   - Magnitude of change in water quality will be greater but duration will be shorter.
   - Ambient flow conditions will exert a significant influence.
   - Unless acute impacts are apparent, more timely monitoring will be required.
   - Concentrations are more important than loadings.

DD. ***Determine why you're monitoring***

The first step in designing a watershed monitoring program is to define the reasons for it. This involves a number of steps:

0. Research existing reports, data, and standards.
1. Identify uses, values, and threats.
2. Identify issues: conflicts among uses, values, and threats.
3. Define program goals: what are your goals for your water body?
4. Define specific monitoring questions. The specific questions you develop will provide the basis for making the other choices.

EE. ***Decide what watershed indicators you'll monitor***

Indicators help assess environmental or human health conditions and trends. The following definition places indicators in the context of watershed assessment: An indicator is a measurable feature that provides evidence of

- the magnitude of stress, or
- the degree of exposure to stress, or
- the degree of ecological response to the exposure, or
- habitat characteristics.

There are three types of indicators:

Early Warning: Indicators that can detect early signs of ecosystem change.
Compliance: Indicators that tell us whether we've achieved our ecosystem objectives.
Diagnostic: Indicators that provide insight into the causes of problems.

Indicators provide essential information about whether management objectives have been achieved and whether actions are working. Management objectives for watersheds include the following:

- fish, shellfish, and wildlife consumption
- aquatic life support
- water supply and food processing
- recreation: fishing
- recreation: water contact
- hydropower
- industrial
- forestry
- agriculture
- transportation

The main categories of indicators are:

- Biological indicators (e.g., macroinvertebrates, fish, wildlife, pathogens)
- Chemical indicators (e.g., pH, dissolved oxygen, nutrients)
- Physical habitat indicators (e.g., gradient, bottom composition)
- Watershed-level stress indicators (e.g., pollution loading, land use)
- Ecosystem integrity indicators (e.g., habitat quality, aquatic life support)
- Public health indicators (e.g., occurrence of disease, closed shellfish waters)
- Human land and water use indicators (uses supported)
- Economic indicators affected by ecological condition (e.g., property values)

NOTE: *For a more complete listing of indicators in each of these categories, see the Session 5 workshop titled "Watershed Indicators: A Closer Look".*

Following are some things to think about in selecting indicators:

Scientific considerations

- Does the indicator help you answer your questions?
- Can you measure and quantify it?

- Does it respond over a reasonable time period?
- Can you isolate the conditions that cause it to change?
- Does it integrate effects over time and space? Does it respond to changes in other indicators?
- Is it a true measure of the condition you're assessing? Is there a reference condition?
- Does it provide early warning of changes?

Practical/programmatic considerations

- Do you have the resources to measure the indicator?
- How difficult is it to measure?
- Does it help you understand a major part of the ecosystem?
- Is it explainable to your target audience?

FF. ***Determine your data quality requirements***

Decide whom you expect to use your data and for what purpose. These users and uses will determine your requirements for the quality of your data. Briefly, these requirements will cover the following:

For sampling
Completeness: how many samples do you need?
Representativeness: how representative are your samples of the conditions you are monitoring?

For analysis
Precision: how close do repeated measurements have to be to each other?
Accuracy: how close do measurements have to be to the true value?
Sensitivity: what is the minimum level of an indicator you must detect?
Data quality requirements should be listed for each indicator.

GG. ***Decide what methods you'll use***

Once you've selected indicators and established your data quality requirements, the next step is to select a method for sampling and analyzing each indicator. The table on the following page lists the various types of monitoring methods. For each type, there is at least one (and probably several) specific methods available.

Following are some questions to consider when selecting methods:

Scientific considerations

- Does the method meet your data quality requirements?
- How accurate is it?
- How precise is it?

- How sensitive is it?
- Will it measure the indicator in the range you need?
- Does it yield samples that are representative?
- What lab facilities and equipment are required?
- Is it comparable to methods used by agencies collecting similar information?

Practical/programmatic considerations

- Do you have the resources to do it?
- How difficult is it?
- How time-consuming is it?
- How expensive is it?
- Will it produce data useful to your target audience?

HH. ***Decide where you'll monitor***

Where you sample is determined by what you want to know and what indicators you're measuring. 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, sampling stations should be located at 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 human alteration (such as a pollution discharge) on a water body, sites should be chosen to isolate the impact being assessed from other potential impacts. To select sample sites:

0. Use a topographic map to do a preliminary selection of sites that appear to meet your study goals.
1. Field-check each site for accessibility, representativeness, safety, and appropriateness. Record directions to the site, a brief description of the site, and other relevant information on a field sheet.
2. Photograph each site at the sample collection point.
3. Place the site description and the photograph in a loose-leaf binder for permanent archiving.
4. Map each site.
5. List all the sites selected, along with the rationale for each site, in your study design. Following are guidelines for selecting sampling locations for each type of water body.

For rivers:
The relatively quick downstream movement of water (and pollution) is reflected in the site selection guidelines.

General site selection guidelines

6. Sampling stations should be located at a variety of sites that represent the variety of conditions in the watershed. These might include:
    - waters located in areas of different land uses (urban, agricultural, forested)
    - streams and rivers of different orders (sizes)
    - waters located at different altitudes
    - waters receiving point source discharges
    - waters receiving nonpoint pollution
7. Where possible, sites historically monitored by the state water quality agency.
8. Sites at areas of public use for water contact recreation (e.g., swimming areas).
9. Sites at habitat areas of sensitive species (e.g., holding or spawning areas important to Atlantic Salmon and other cold water species).
10. Sites that are representative of the part of the river of interest.
11. Sites that are *safely accessible*. Avoid steep, slippery, or eroding banks or sites where landowner permission cannot be obtained.
12. 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.
13. 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.

Benthic macroinvertebrate site selection guidelines
Sites for macroinvertebrate collection should be shallow (1-2 feet deep) "riffle" areas with current between 0.4 and 2.0 feet per second, and rocky/gravelly bottoms.

Pollution or erosion impact site selection guidelines
Generally, three sites should be chosen to "bracket" the polluting/eroding areas:

14. **a reference or control site** immediately upstream of any potential impact
15. **an impact site** immediately downstream of the alteration (at the point where the impact is completely integrated with the water)
16. **a recovery site** downstream stream of the impact (where the water has at least partially recovered from the impact)

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

Tributary impact site selection guidelines Consider tributaries as nonpoint discharge "pipes" to the main stem. Four sites should be chosen to bracket the tributary confluence.

17. **a reference or control site** immediately upstream of the tributary confluence
18. **an impact site** immediately downstream of the tributary at a point where the water from the tributary is completely integrated with the main stem water
19. **a recovery site** downstream stream of the tributary where the main stem water has at least partially recovered from the impact (for example, downstream from where a cleaner tributary has entered)
20. **an "integrator" site** in the mouth of the tributary. Be sure that you are not sampling a backwater of the main stem.

For lakes:
Lakes are relatively closed water bodies, lacking the strong downstream movement of rivers. However, strikingly different conditions may exist throughout the lake depending on shape, embayments, depth, and wind fetch. The first step is to get a bathymetric map of your lake showing depth contours, inlets, and outlets. Use it to identify the following sites:

General site selection guidelines

21. The primary sampling station(s) should be located at a site that represents the typical condition of the lake. The best sites will be in the deepest part of the lake, or, in the case of a large lake, the deepest part of an arm or bay. Avoid nearshore areas, areas near inlets, secluded areas that may lagoon, or areas downwind that may collect windblown algae and debris.
22. Where possible, sites historically monitored by the state water quality agency.
23. Secondary sampling sites may include tributary inlets; outlet; extensively developed or cleared vs. non-developed shoreline areas, coves, or embayments; areas with older development; or seasonal camp to year-round conversions.
24. Sites at areas of public use for water contact recreation (e.g., swimming areas).
25. Consider the influence of temperature stratification. For chlorophyll analysis (algae biomass surrogate) you might want to take an integrated (composite) sample of the open water epilimnion as a representative sample. For oxygen or phosphorus you may want to get a point sample close to the bottom of the lake to check for stagnation and internal nutrient loading.

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.

General site selection guidelines

26. Where possible, sites historically monitored by the state water quality agency.
27. Sites at areas of public use for water contact recreation (e.g., swimming areas).
28. Sites which are representative of the part of the estuary of interest.
29. Sites that are safely accessible.
30. Sites should be located in the main current and away from the banks or shoreline. If that is not possible, locate the site where homogeneous mixing of the water occurs, such as on an outside bend of the shoreline.
31. **Consider variable flow patterns caused by artificial physical structures such as piers, groins, and bulkheads. These may influence the representative quality of the water.**
32. **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.**

II. ***Decide when you'll monitor***

The whys of monitoring, your resources, and your data objectives will often dictate when you monitor. It is important to try to consider all of the many factors that will have an influence on the indicator you've chosen:

- **Will there be seasonal differences due to natural conditions or resource use/impact timing?**
- **Are there base flow, low flow, and high flow conditions to be monitored?**
- **Do groundwater levels have an influence?**
- **Will tidal cycles make a difference?**
- **Should monitoring be done during storm events? If so, how big a storm is significant and at what stage should monitoring start?**
- **Is any stocking, removal, or harvesting of organisms done?**
- **Are dam releases or lake draw-downs scheduled?**
- **Are there life-cycle details that are important?**

In addition, methods employed might influence the scheduling of sampling:

- **Do you have to return samples before a hold time expires or a lab closes?**
- **Are there time-of-day or sun-angle considerations? (e.g., Secchi disk)**
- **Are there time-dependent safety considerations?**
- **Is it easier to conduct a visual survey in the fall after trees have lost their leaves?**

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CONCURRENT SESSION 5

Watershed Indicators: A Closer Look

Moderator: **Geoff Dates,** River Watch Network
Presenters: **Geoff Dates; Mike Rigney,*** San Francisco Estuary Institute; **Cynthia Lopez,** Harvard School of Public Health/River Watch Network

Geoff Dates
River Watch Network, 153 State St., Montpelier, VT 05602, 802/223-3840

Brief Overview of Watershed Ecology and Indicators

NOTE: Some sections of this presentation repeat material presented in Session 4. "Developing a Watershed Monitoring Plan."

A *watershed* is a geographic area in which water, sediments, and dissolved materials drain into a common outleta point on a larger stream, a lake, an underlying aquifer, an estuary, or an ocean.

A *watershed ecosystem* is a functioning interacting system composed of living organisms and their physical (including both land and water) and chemical environment, including upstream-downstream relationships.

Watershed processes occur in predictable patterns along a continuum, based on the upstream-to-downstream changes in the watershed's physical characteristics. These changes in the physical environment produce corresponding changes in the biological communities that are also predictable. This is known as the river *continuum concept.*

Physical/chemical processes

The main physical and chemical processes at work in a watershed are geology, light, temperature, water current, and nutrients. The fundamental physical process at work in a watershed is the cutting of stream channels and the carrying of materials downstream. This process is governed by the underlying geology of the watershed.

Geology determines the gradient of the stream, which determines the current velocity. Current velocity helps determine the composition of the stream bottom (by sorting different particle sizes), which helps determine what can live there. The watershed geology may form deep canyons, which may shade the river for long periods of daylight hours. This limits light penetration. *Light penetration* is important in determining water temperature and photosynthesis, the energy that drives the whole biological system. Water temperature helps determine the water's dissolved oxygen content and governs the rate of many biological processes. Watershed geology also helps determine the nutrient and dissolved mineral content of the water. For example, limestone geology tends to contribute more dissolved nutrients and minerals to the water, providing essential materials for biological activity. Nutrients can enter the stream dissolved in runoff, attached to eroded soil particles, or in decomposing organic matter.

The net result of the physical processes is the foundation for the biological processes.

Biological processes

The fundamental biological process at work in the watershed is photosynthesis, the process by which plants convert sunlight into organic tissue. This process happens both in the water and on the land and provides food for a host of other types of organisms.

Plants that convert sunlight into food are known as *primary producers*. In the stream they include algae, mosses, and rooted plants. On the land they include trees, mosses, grasses, shrubs, and trees. This plant material is a food source for *secondary producers*. In the stream, these include microscopic animals, invertebrates (such as insects, clams, crustaceans, and worms), and vertebrates such as fish.

Food for stream organisms is produced both instream and out-of-stream. Instream sources include primary producers growing on the bottom and in the water column. This material is harvested by *grazers* and *filter feeding* organisms, such as aquatic insects. Out-of-stream sources include leaves and other plant and animal material that drops into the water. This is known as *coarse particulate organic matter* (CPOM). CPOM is immediately attacked by *decomposers, shredders, and gatherers,* which break down these large particles into *fine particulate organic matter* (FPOM). The FPOM is then carried downstream where it provides food for filtering organisms. Finally, the stream organisms which consume plant material are themselves food for *predators.*

The food sources and the organisms that feed on them tend to change upstream to downstream. In the headwaters, the food source is primarily out-of-stream CPOM from overhanging vegetation. Organisms that process CPOM dominate. This same overhanging vegetation limits instream production by preventing sunlight from reaching the water. As the stream widens, overhanging vegetation shades less of the stream, and benthic (on the bottom) instream production becomes more of a factor. Grazers and collectors become more prevalent. In larger rivers, neither overhanging vegetation nor benthic instream production is as much of a factor as FPOM carried from upstream and plankton and algae in the water column. Filtering organisms dominate here. So, how organisms are distributed in a stream is determined, in part, by the food source.

It's also determined by habitat types. These types include *riffles, runs,* and *pools*. These habitats are created by the physical processes described above. They form a gradient from fast-moving, shallow water with relatively large particles on the stream bottom (boulders and cobbles) in riffles, through slower deeper areas with smaller particles on the bottom (gravel and sand) in runs, to deep slow water with silt and mud bottoms in pools. Each of these provides different types of niches for different organisms - for example, cover for fish and attachment surfaces for aquatic insects. These occur along the upstream-downstream gradient according to the geology of the watershed, generally from larger bottom materials in the headwaters to fine particles in the lower reaches. Habitat diversity (and therefore biological diversity) tends to be highest in the mid reaches.

What are indicators and how are they used?

In typical lyrical fashion, the U.S. EPA defines environmental indicators as follows:

A measured or observed property or some value derived from properties which provides managerially significant information about patterns or trends in the state of the environment or about relationships among such variables.

Here's another definition--one that places indicators in the context of watershed assessment:

An indicator is a measurable feature that provides evidence of the magnitude of stress, or the degree of exposure to stress, or the degree of ecological response to the exposure, or habitat characteristics.

Taken together, these two definitions describe indicators as measurable features that help assess environmental or human health conditions and trends.

There are three types of indicators:

1. Early warning: Indicators that can detect early signs of ecosystem change.
2. Compliance: Indicators that tell us whether we've achieved our ecosystem objectives.
3. Diagnostic: Indicators that provide insight into the causes of problems.

Indicators provide essential information about whether management objectives have been achieved and whether actions are working. Management objectives for watersheds include the following:

- fish, shellfish, and wildlife consumption
- aquatic life support
- water supply and food processing
- recreation: fishing
- recreation: water contact
- hydropower
- industrial
- forestry
- agriculture
- transportation

The use of indicators in the decision-making process is shown schematically below.

Categories of indicators

The main categories of indicators are:

- biological indicators
- chemical indicators
- physical habitat indicators
- watershed-level stress indicators
- ecosystem integrity indicators
- public health indicators
- human land and water use indicators
- economic indicators (affected by ecological condition)

The box on page 64 shows a list of indicators in each of these categories. This list was compiled from the sources listed in the references. Consider it a sampling, not a comprehensive list.

Choosing appropriate indicators

Choosing among this bewildering array of indicators is part of the process of designing your monitoring program. This process includes researching your watershed, framing specific questions you wish to answer, determining who's going to use this information and for what purposes, selecting indicators to answer your questions, selecting methods to measure those indicators, selecting monitoring locations, determining monitoring frequency, and quality assurance.

So, selecting indicators is just one of these steps. Following are some things to think about when selecting indicators:

Scientific considerations

- Does the indicator help you answer your questions?
- Can you measure and quantify it?
- Does it respond over a reasonable time period?
- Can you isolate the conditions that cause it to change?
- Does it integrate effects over time and space? Does it respond to changes in other indicators?
- Is it a true measure of the condition you're assessing? Is there a reference condition?
- Does it provide early warning of changes?

Practical/programmatic considerations

- Do you have the resources to measure the indicator?
- How difficult is it to measure?
- Does it help you understand a major part of the ecosystem?
- Is it explainable to your target audience?

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Cynthia Lopez
11024 Montgomery NE, #127, Albuquerque, NM 87111, 505/296-7547

A Closer Look at Human Health Indicators

Human health, well-being, and quality of life may be adversely impacted by disturbances in the health of a watershed ecosystem. Contaminants such as sewage or toxic chemicals that are dumped into a waterway can adversely affect not only the watershed, but also the human and animal life that comes into contact with the water. Degradation of a waterway can also affect human health by creating a favorable environment for waterborne disease agents to thrive and cause illnesses.

Humans cannot be treated like animals or insects, which can be placed in experimental laboratory settings, purposely exposed to varying doses of contaminants, and then "sacrificed" to see if any adverse health effect has occurred. Therefore researchers use the discipline of *epidemiology*, defined as "the study of the causes and distribution of disease in human populations," to examine the occurrence of disease within defined human populations. Epidemiologists look at disease in the presence and absence of exposure to contaminants, while controlling for exposures to other disease-causing agents. Once the exposure and disease status of a human, or group of humans, is known, an epidemiologist compares unexposed and exposed groups to see if there is a difference in getting disease.

Epidemiologic research is generally considered the strongest evidence of potential human health effects from contamination.

Monitoring human health indicators incorporates principles common to both epidemiology and water monitoring. For example, in both epidemiology and water monitoring, the researcher usually studies a representative sample.

For human samples, it is important to determine the human's *exposure* to the water contaminant that can cause disease. For example, humans come into contact with water by swimming, fishing, and recreating. Methods for assessing whether humans are exposed to disease-causing agents found in water include (1) using surveys that ask people to report their behavior, (2) observing humans in the field, (3) looking at medical records, or (4) sampling human tissue (blood, skin, etc.) and examining it in the lab.

It is crucial to determine whether humans are sick, or become sick, in relationship to their exposure. The presence of disease can be examined in many ways, including the collection of biological samples such as blood or tissue, physician exams, or symptom reports using surveys.

Most human health studies are difficult to do because they are time-consuming, costly, and an imposition on the people who are interviewed or examined. Subtle or small health effects may be difficult to find and measure. To detect rare diseases, sometimes a large sample size is needed. To detect long-term effects, the population must be followed for a long time period. Effects of contamination may not be detected in time to prevent widespread health problems.

In spite of these difficulties, gathering human health data can be a valuable complement to other aspects of watershed monitoring. Clearly, it has the potential to generate public interest in volunteer water monitoring because the results are usually extremely relevant to the people living in the watershed. Using volunteer labor lowers the costs typical of an epidemiologic study. Also, because volunteers usually are from the community in which they monitor, they often have valuable "inside" information about the region and the people that can be incorporated into a health study.

Currently, few volunteer monitoring organizations use their data in epidemiologic studies or actually monitor human health. Two groups that are monitoring human health *are* the Rio Bravo River Watchers (RBRWs) and the Missisquoi River Keepers. The RBRWs are surveying residents who live in impoverished human settlements on the floodplain of the Rio Grande/Rio Bravo. These residents come into contact with the river by swimming and fishing in it. Their wells are also located in the drainage basin of the river. Many of these residents suffer from respiratory and gastrointestinal illnesses that are associated with their contact with the river.

The Missisquoi River Keepers are monitoring the Missisquoi River and its fish for mercury. They are interviewing anglers about fish consumption behavior and health problems. Few anglers are aware of the fish consumption advisory in the state of

Vermont. Many anglers, particularly those of Native American descent, continue to consume large quantities of mercury-laden fish from this river.

Data on human use of watershed resources is a related type of data that can also be monitored in a volunteer program. Human use of resources will respond to environmental degradation. For example, restrictions on water use may result from degradation of a watershed, or fish consumption or swim warnings may be posted due to contamination. There may also be a decline in the commercial fishing industry or recreational use. Monitoring human use indicators typically involves inventorying current use, determining the quality of the resource, attaching dollar values to the resource, and then comparing results to some baseline. For example, current fish harvest rates may be compared to replenishment rates to determine the potential for depletion.

Human *perceptions* of environmental quality, and quality of life, may contribute to watershed resource management decisions. Common indicators of perceptions of environmental quality include overall satisfaction with current conditions, property values, and resource use. Monitoring perceptions may involve opinion surveys, questionnaires, or other data regarding human use.

One limitation of human use or perception indicators is their reliance upon attaching monetary value to resources. Some resources are not amenable to such valuation. In addition, current generations may inappropriately estimate the net present value of such resources, harming future generations.

To my knowledge, no volunteer monitoring group currently monitors human use or perception indicators.

Innovative Observations

Moderator: **Rebecca Pitt,** Maryland Save Our Streams

Speakers: **Diane Calesso,** U.S. EPA Region 2; **Gary Casper**,* Milwaukee Public Museum; **Jill Goodman Bieri**, Center for Marine Conservation; **Valerie Brennan**, Gunpowder Valley Conservancy

Diane Calesso
U.S. EPA Region 2, 2890 Woodbridge Ave, Edison, NJ 08837, 908/906-6999

Reef Fish Monitoring by Divers

The objectives of the Fifth National Volunteer Monitoring Conference include expanding watershed stewardship, monitoring environmental trends, and encouraging a commitment to growth and development of volunteer monitoring in the U.S. and worldwide. REEF, the Reef Environmental Education Foundation, has had these same objectives since its inception in 1991. REEF is a volunteer group of over 6,000 SCUBA divers from 50 states and 41 countries who survey tropical reefs. Just as bird watchers with the Audubon

Society count and identify birds, REEF volunteers identify fish species they sight while diving.

Some scientists have described coral reefs as "the rain forests of the sea." These fragile ecosystems are being threatened by anthropogenic influences before their resources have even been understood. The marine environment offers virtually untapped resources for pharmaceutical research. A reef is the first natural defense from the destruction of storms. Coastal states use artificial reefs to bolster their shorelines and to increase breeding habitat for commercial and recreational fisheries. In the United States alone there are now 13 designated Marine Sanctuaries as well as natural coral reef systems in Florida, Hawaii, and the U.S. territories of Guam, Puerto Rico, the U.S. Virgin Islands, American Samoa, and the Northern Mariana Islands.

REEF trains recreational divers to positively identify fish species by performing "roving diver" surveys. These surveys help identify the geographical distribution of species. The diver also has the option of estimating the abundance of each species sighted. Species and abundance surveys provide a clearer picture of fish populations and fluctuations over the years and between seasons. The University of Miami compiles the data and makes it available to anyone interested. Managers of the Florida Keys National Marine Sanctuary are already reaping the benefits of this baseline information to help create their management strategy for this recently designated marine reserve.

The validity of using volunteer divers was closely studied during the summer of 1993. The results have been published by E.F. Schmitt and K.M. Sullivan (see reference list below). The paper concludes that data collected by volunteer divers with only basic training provides a valuable species list and abundance record that uniquely characterize the environment.

REEF volunteers currently conduct coral reef surveys in the waters of Florida, the Bahamas, and the Caribbean. Their future goal is to collect species and abundance data throughout the world, on a continuing basis, on all the plants and animals that make up the coral reef ecosystem.

A survey of diving enthusiasts in 1983 by Skin Diver magazine noted that 1.2 million divers took 600,000 trips to locations with coral reefs in the continental United States. Imagine the invaluable information these divers could provide if trained as REEF volunteers!

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Humann, P., and N. DeLoach. 1991. *Reef Fish Identification*, 2nd edition. New World Publications, Inc., Jacksonville, Florida. 396 pages.

Schmitt, E. F., and K. M. Sullivan. 1996. Analysis of a Volunteer Method for Collecting Fish Presence and Abundance Data in the Florida Keys. *Bulletin Marine Science* vol. 59.

Jill Goodman Bieri
Center for Marine Conservation, 306A Buckroe Ave., Hampton, VA 23664, 804/851-6734

The National Marine Debris Monitoring Program: Using Trained Volunteers Nationwide

The National Marine Debris Monitoring Program (NMDMP) is an EPA program that is being coordinated by the Center for Marine Conservation to answer specific questions regarding the sources and trends of beach debris. The program utilizes trained volunteers nationwide.

Marine debris has been recognized as a significant pollution problem since the early 1970s, when it was estimated that close to 14 billion tons of garbage were dumped into our oceans every year. This does not even include garbage that has its sources on land. Not only is debris on our beaches unsightly, but the costs to wildlife habitat and human and animal well-being are enormous.

The data from the past 10 years of the International Coastal Cleanup has enabled us to classify debris into two major categories: ocean- and land-based. Sources of ocean-based debris include recreational boats, cargo ships, passenger day boats, small public vessels, commercial fishing vessels, offshore oil platforms, rigs and supply boats, passenger cruise ships, and research vessels. Ocean-based debris is generated during the normal course of vessel operations and may also be accidentally lost or discarded at sea. Sources of land-based debris include stormwater drains, inadequate sewer systems, landfill sites, plastic manufacturers and processors, offsite balloon releases, and beach-goers. Land-based debris reaches the ocean via inland waterways or is directly discharged into coastal water.

In 1988, the U.S. Congress ratified Annex V of the international treaty on marine pollution known as MARPOL. Ratification addressed the centuries-old practice of disposing of ship-generated garbage at sea. Annex V prohibits the disposal of all plastic garbage and establishes limits on disposal of other garbage. Unfortunately, MARPOL and other agreements and legislation do not guarantee that there will be less trash in our oceans. Not only is enforcement of these laws difficult, but in some areas 60-80% of shoreline debris is from the aforementioned land-based sources. In addition, there was no way to measure the effect of MARPOL and other regulations on the amount and types of marine debris that end up on our beaches. Monitoring programs were needed to measure these changes.

Representatives from EPA, NOAA, NPS, USCG, CMC, and selected scientists formed a Marine Debris Monitoring (MDM) Workgroup in the early 1990s to design a statistically rigorous marine debris monitoring program that meets all federal agencies' goals and guidelines. The Workgroup met for over two years and developed the NMDMP protocol. The U.S. was divided into nine regions based on ocean current patterns, marine debris information, and logistics. Power analysis was used to determine the necessary number of sites per region, size of sampling area, common debris items, and frequency and duration

of sampling to detect a change over time. CMC established pilot studies to collect data for power analysis and to answer other questions (e.g., Can volunteers collect scientific data? Does debris move laterally along the beach?).

Like any scientific program, the NMDMP was designed to answer specific questions: (1) Is the amount of debris on our coastlines decreasing? and (2) What are the sources of this debris? The Workgroup, using results from the power analysis, came up with general survey details: 20 sites will be selected within each of the nine U.S. regions; volunteers will sample each 500-meter site monthly for a period of 5 years; and the survey will measure trends of 30 specific common debris items. The protocol standardized the selection of shoreline to include only beaches that meet the following criteria:

- sandy or small-gravel composition
- moderate to low slope
- no other routine cleaning
- unprotected from ocean
- accessible for monthly cleaning
- at least 1,500 meters of accessible length.

Surveys will be conducted every 28 days, as close to low tide as possible, and all 20 sites within a region will conduct their survey on the same day, using a specific walking pattern to cover the entire area.

Volunteers will collect data on 30 specific items monthly while adhering to quality assurance procedures (QAP). Quality assurance ensures that independent studies are repeatable and comparable. QAP begins with the design of the protocol and is followed through data collection, compilation, and analysis. One of the most important features of QAP in this program is the training of volunteers. The Program Manager trains Survey Directors, who in turn train their volunteers. Training covers recognition of the 30 debris items, filling in the data card, and the importance of the volunteers' participation. Slide presentations and handbooks are provided for training purposes. Survey Directors conduct QAP four times per year by following behind the volunteers and re-identifying collected items. The identifications are compared and the percent error of data collection is calculated. The NMDMP's structure allows for quality assurance to be followed at all levels.

The NMDMP has been implemented in Regions 4 (Mobile Bay, Alabama, to Port Everglades, Florida, plus Puerto Rico and the U.S. Virgin Islands) and 5 (border of Mexico to Mobile Bay). Forty sites within these regions are surveying monthly and submitting their data to CMC for analysis. Regions 2 (Cape Cod to Beaufort, North Carolina) and 3 (Morehead City, North Carolina, to Port Everglades) will be implemented by the spring of 1997.

Valerie Jane Brennan
Gunpowder Valley Conservancy, 25 Burke Ave., Towson, MD 21286, 410/296-9164, vbrennan@umd5.umd.edu

Monitoring Construction Sites

What is sediment pollution?

Pollution has degraded the water quality of many U.S. rivers, lakes, bays, and oceans. Pollution stems from many different sources, including one that is far from obvious. When soil enters a waterway in excessive quantities, the result is sediment pollution.

While all lands erode, only a few are significant sources of sediment pollution. For instance, erosion on forested land rarely exceeds one-half ton per acre per year. Generally, croplands and mining and construction sites erode to a degree that is sufficient to cause sediment, or "mud," pollution. While soil loss from farmland is approximately 7 tons per acre per year, each acre on a construction site can release more than 100 tons of mud per year into downstream areas.

Sediment can be just as deadly to aquatic life as cyanide or DDT. Sediment blocks sunlight for photosynthesis, clogs gills, and coats aquatic larvae. In the 1950s, construction of a bridge in Maryland resulted in the killing of over 100 million yellow perch fish eggs and larvae when several storms washed mud into the river.

The accumulation of sediment may cause fish barriers and sediment bars. It may close tributaries, fill in reservoirs, or necessitate costly dredging operations. When mud pollution fills in water supply reservoirs, it reduces the available capacity for water retention. In addition, the removal of suspended sediments accounts for much of the cost of treating drinking water.

Sediment pollution robs boating and shipping channels of depth, necessitating expensive dredging at public expense. The cost of a current dredging operation in the Baltimore Harbor is in the vicinity of $300 million.

Sediment also binds with toxins like lead, zinc, fertilizers, and pesticides and carries these pollutants into the water through runoff. Fish and other organisms may bioaccumulate toxins carried from sediment, which may affect organisms along the food chain. The loss of revenue from a decline in aquatic resources can affect the livelihood of millions of individuals through lost business, license fees, taxes, and tourism. A study conducted by Maryland Save Our Streams in 1993 showed that for each dollar spent keeping sediment on construction sites taxpayers would save $83 in waterway maintenance and restoration expenses.

How is sediment pollution controlled?

Local, state, and national laws have been enacted that require builders to develop plans to keep sediment on construction sites and out of our waters. Prior to disturbing the earth, the builder must submit a sediment control plan for the approval of local sediment control authorities or Soil Conservation Districts (SCD). Before construction can begin, that

sediment control plan must be reviewed and must conform to specific standards and specifications to retain the maximum amount of sediment on site.

By law, the sediment control plan will call for two approaches to minimizing off-site soil loss. The first approach is *perimeter control*. This approach relies on the use of various devices to slow the velocity of the runoff and capture the sediment (see box). Basins and traps are essentially holding ponds for runoff, and rely on settling to control soil loss. Straw bales and silt fences filter the runoff as it passes through, removing the sediment and holding it onsite.

Perimeter control devices are located at the downslope perimeter of exposed soils. A system of ditches, dikes, or swales will be used to divert runoff to these devices. The devices are designed to store the settled particles of sediment. Perimeter control can stop 30Ð70% of the eroded soils from leaving the site. Their effectiveness will vary according to many factors, including the erodibility of the soil, the degree of slope on the site, and the condition of the devices themselves.

The second approach is known as *temporary stabilization*. Temporary stabilization measures are designed to reduce the susceptibility of soil to erosive forces. The best type of sediment control is natural ground covertrees or grass. The next best is temporary seeding and straw mulch applied so that no bare exposed soil shows through the mulch. Total coverage is important because the mulch serves to *lessen the impact* of rain as it strikes the ground, to *slow down* the rain as it follows its runoff route, and to *hold the soil* from being moved by runoff. Mulching can reduce sediment pollution by 95%. Work areas where mulching is not practical, such as roads and access points, must be covered with crushed rock.

Temporary stabilization is required on all exposed soils not currently undergoing grading and is much more effective than perimeter controls alone. The higher level of effectiveness makes temporary stabilization the most desirable method of controlling sediment pollution.

Once the plan is approved, the builder can begin site development. Maryland state law requires the builder to ensure that one of his or her employees is trained in sediment control. This person must carry a card certifying that they have completed an erosion and sediment control training program. It is this person's responsibility to check required erosion and sediment control measures at the end of each working day and make sure that each measure is in proper working order.

Maintenance is the key to the effectiveness of both perimeter controls and temporary stabilization. Both measures require steady attention. Silt fences and straw bales may wear out, basins and traps may need to be emptied, and a temporary seeding may not take the first time. Sediment control enforcement authorities must visit every major construction site on a regular basis. The inspector may represent a city, county, or state. The inspector walks the site to determine whether the builder is in fact complying with the sediment control plan. The provisions of the plan are enforced through verbal or

formal written orders to correct any deficiencies. If the builder fails to make repairs within a specified time, the inspector may issue a "Stop Work Order." This order halts all work on site except that necessary to correct the violation, which is a very costly penalty to builders. Legal action may subject the violator to a fine, imprisonment, or both.

Sediment Control Devices

Sediment basin: resembles a pond and is normally fitted with a spillway constructed of corrugated metal pipe. Like all perimeter control measures, basins trap sediment by slowing down the velocity of the runoff to the pond. "Ponding" can only occur if the basin spillway is constructed watertight.

Sediment trap: also resembles a pond, but is smaller than a basin and usually served by a spillway constructed of 2-to-8-inch stone.

Straw bale dike: consists of a row of straw bales tightly butted together, set into a trench and firmly staked into the earth. A straw bale dike cannot drain excessively long slopes. Straw bale dikes are only effective for about 3 months. There must not be any point along the dike where rainwater runoff could flow beneath the bales.

Silt fence: consists of a fine mesh synthetic fabric (known as filter cloth) which is usually colored black and supported by a wire fence. The bottom of the cloth must be inserted into the earth to a depth of about 8 inches. If there is any point where the cloth is torn or deeply filled with mud, or where runoff could flow under, over, or around, record this violation.

Storm drain system: can allow sediment-laden runoff to bypass perimeter control measures. The existence of storm drains on a site will be revealed by the presence of inlets along the streets. If storm drains are present, determine where the collected runoff discharges. If the runoff is released into a basin or trap, the system can be disregarded. If, however, the storm drain system bypasses control measures, each inlet must be protected. There are three ways to protect the inlets: (a) seal the inlet completely and divert runoff to a basin or trap, (b) install a sediment trap at the inlet, and (c) reduce sediment entry by layering filter cloth across the opening which is then covered by stone.

Surveys by Maryland Save Our Streams have shown that despite this rather comprehensive program, only 15Ð25% of all active construction sites fully comply with sediment control standards. This means that thousands of tons of sediment are allowed to enter waterways needlessly every year. Maryland Save Our Streams has assisted community groups in becoming actively involved in sediment control practices. Campaigns coordinated by volunteers across Maryland have achieved correction of sediment control violations on thousands of sites since the early 1970s. In 1992 the Gunpowder Valley Conservancy held a two-day Construction Site Monitoring Workshop during which local residents received hands-on training in the field by inspectors,

Maryland Save Our Streams staff, and cooperating builders. Those who attended the second day's workshop were trained in the state's sediment and erosion control program and were certified. The participants were asked to complete a survey of their neighborhoods and evaluate construction sites within a three-week period.

The goal of the Gunpowder Valley Conservancy's Construction Site Monitoring Workshop was to train a core of volunteers who would work with builders to ensure that the site was in compliance with sediment control standards. Reporting noncompliance to sediment control authorities was discouraged since it has been our experience that builders work with the volunteers to evaluate and correct the problems, without intervention from the authorities.

What can I do?

Whenever you pass a construction site, look the site over and ask yourself, "Would rainwater runoff from all the exposed soils drain to a pond, a row of straw bales, or a silt fence?" To conduct a survey, stay on the public portion of the site. You should be able to see all you need from adjacent public areas. You may be trespassing even if you walk on completed sidewalks, streets, and other public areas of the development. You should never venture onto any portion of the site where heavy equipment is operating.

Usually, the names of the developer and builder are located on a sign advertising the development. It may be a good idea to contact the builder or developer and ask them for permission to tour the site, perhaps with one of their supervisors. It has been our experience that most builders and developers have allowed us to view the site and that some have come out to tour it with us!

What to look for

Construction site monitoring takes a little bit of knowledge about regulations and structural devices and a lot of common sense. Before you visit the site, you may want to call your local sediment control enforcement agency and ask for a publication on regulations concerning construction sites and talk to one of the inspectors. When you visit the site:

1. Record the date, the location and name of the development, and names of persons you have contacted.
2. Survey the entire construction site and note the percentage of the site that is not covered by temporary stabilization (e.g., grass, straw, mulch, crushed stone). Record this as the percentage of bare, exposed soil. These bare areas will be the main source of sediment pollution from the construction site. Again, all soils that are not treated with temporary stabilization must drain to a functioning perimeter control measure. To verify compliance with this requirement, proceed to step 3.
3. Walk the entire downslope perimeter of the site to determine if there is any point where runoff from exposed soils could exit the site prior to reaching a basin, trap, row of bales, or silt fence. If you find any point of escape, record the exact

location and write a description of the problem. For example, you may write "Silt fence knocked down and mud is spilling over off site 50 yards east of the southwest corner of the development."

4. Check the condition of the sediment control devices and record any visual problems or questions you may have along with the name of the device and a description of the location.
5. If you note any portion of the site where exposed soils are not being frequently disturbed by foot or equipment traffic, request the builder or sediment control enforcer to require temporary stabilization of the area.

If you contact the builder or sediment control enforcement authorities, give a clear location of the site and a concise description of the violation. Note the name of the individual who took your report and record the date and time the referral was made. Request that you be notified of the site investigation.

Saving our waterways

We tend to rely on government to end our water quality woes, but the job is too big for government alone. A sediment control plan can only succeed if it is actively supported by the public. Gathering information from construction sites throughout an entire watershed will enable an organization to organize a campaign to curb mud pollution. Construction site monitoring may be performed by an individual, but it is more effective and fun when done with a group.

For more information about monitoring construction sites, you may contact Valerie Brennan at 410/296-9164, e-mail vbrennan@umd5.umd.edu; or Maryland Save Our Streams at 410/969-0084.

Restoring Stream Habitats

Moderator: **Karen Firehock,** Izaak Walton League of America

Speakers: **Dennis O'Connor,** restoration ecologist; **Don Rosebloom,*** Illinois State Water Survey

Dennis O'Connor
P.O. Box 42447, Portland, OR 97242, 503/292-2087

Enhancing Stream Habitats

To achieve water quality benefits, enhancement projects need to:

- reduce sediment transport to the river and its streams by stabilizing streambank soils
- reduce nutrient loadings by controlling excessive erosion
- minimize temperature gains in tributary streams by shading the water

- reduce bacteria loads by providing a vegetated filter between human or farm activities and the stream

Enhancement projects may also provide additional benefits, including:

- flood management
- habitat protection
- passive recreation
- public safety
- education
- aesthetics

Following are the steps to take in developing a Stream Enhancement Project:

1. Obtain information (maps and data) on the watershed where the stream is located.
2. Complete a landscape characterization and analysis. The five major components will be: historic timeline, soil study, hydrology/water quality, land use, and habitat characteristics.
3. Determine preliminary site potential and characterize the site conditions based on the information you discovered in Step 2.
4. Perform a site assessment in the field. You should be assessing the stream system's geomorphology/soils, hydrology/water quality, vegetation, land use, and wildlife habitat.
5. Identify appropriate enhancement techniques. Look at the streamside problems and identify potential enhancement solutions.

Typical streamside problems may include:

Bank: lacking vegetation, scoured, eroding, slumping.

Channel: no shelter for fish/wildlife, artificially straightened, riprap present, debris in channel.

Water quality: high water temperature, elevated phosphorus levels, elevated nitrogen levels, elevated bacteria counts, low dissolved oxygen levels, trash, chemical contamination.

Potential enhancement solutions may include:

- Pole cuttings
- Brush layering
- Fascine bundles
- Branch packing
- Palmiter brush pile
- Tree revetments
- Hand-laid rock

- Live wood crib wall
- Gabions
- Snag and clearing
- Container planting

It is essential to match the appropriate enhancement techniques with the identified problems. Base your decisions on the overall findings from the site analysis.

Here are some general rules of thumb regarding enhancement:

1. Know your site, in all of its seasons.
2. Never disturb a site more than is absolutely necessary.
3. Ask for help from a qualified professional when you are in over your head.
4. Prepare the site from the top down; plant the site from the bottom up.
5. Submit permit applications, when needed, months prior to project installation.
6. Do not underestimate the power of nature to take your project downstream.
7. Recognize that those who live at your site (beaver, deer, birds, people) may change it to suit their needs.
8. Maximize the opportunities and resolve constraints before you develop a plan.
9. A failed monitoring effort typically leads to a failed project.
10. Don't plant trees near the active bankfull flow channel. Keep them above the seasonal high-water mark.

Interdisciplinary Studies and Monitoring

Moderator: **Molly MacGregor,** Mississippi Headwaters Board
Panelists: **Sandy Fisher,** University of Florida Lakewatch; Dwight Shellman,* Caddo Lake Institute; **Patty Madigan,** Adopt-A-Watershed

Sandy Fisher
Florida LAKEWATCH, 7922 NW 71st Street, Gainesville, FL 32653, 352/392-9617 ext. 228

Interdisciplinary Studies and Monitoring by the Students of Eagle Eye, Inc.

Eagle Eye, Incorporated (EEI) is a student-directed environmental monitoring project in the ninth and tenth grades at Walker Memorial Junior Academy in Avon Park, Florida. Each school year EEI will be the cooperative effort of the Biology, Earth Science, and Computer Literacy classes. Two teachers and approximately 40 students will be directly involved in the project.

EEI's "corporate structure"

EEI is modeled after the modern corporation. The corporate officers-president, vice-president, and secretary-are elected at the beginning of the school year. These officers

organize and direct the monthly meetings. Division and department managers are also chosen to provide leadership and experience to the different departments. The officers and managers of EEI are selected from the tenth-grade class, which has one year of experience working in EEI.

There are four divisions of EEI: Data Retrieval, Data Control, Lake Restoration, and Public Relations. Each division includes several departments, which have specific job descriptions. All departmental activities are conducted by students. Following are the job descriptions of each department.

The **Data Retrieval Division** has three departments: Florida LAKEWATCH, Chemical Tests, and Benthic Macroinvertebrates. The LAKEWATCH Department collects monthly water samples from a nearby lake. These are analyzed for total nitrogen, total phosphorus, and chlorophyll a content. This department also measures water clarity and depth and conducts a site survey. These procedures are conducted under the direction of the Florida LAKEWATCH Program at the University of Florida.

The **Chemical Test Department** collects monthly water samples and evaluates the samples for dissolved oxygen, 5-day biochemical oxygen demand, pH, temperature, fecal coliform, total solids, total nitrates, phosphates, and turbidity. Using a statistical analysis method, this department provides EEI with a monthly water quality index.

The **Benthic Macroinvertebrate Department** collects monthly bottom samples to determine the kinds of invertebrates on the bottom of the lake. Using statistical analysis methods, they provide EEI with several indices of water quality-pollution tolerance, sequential comparison, taxa richness, and diversity.

The **Lake Restoration Division** has two departments: Lake Management and Environmental History. The Lake Management Department researches problems that may exist on a lake, primarily using the data from the Data Retrieval Division. Once a problem has been identified, solutions are designed and carried out. For example, a problem of stormwater runoff has been identified, so a storm drain stenciling project is now under way.

The **Environmental History Department** compiles a historical account of the area's geological, social, and economic development. A unique aspect of this historical record is a series of videotaped interviews of local people recounting their memories of the area.

The **Data Control Division** oversees the input of data into the appropriate spreadsheets and databases. This department supplies EEI with charts and tables for both monthly and year-end reports. They also ensure quality storage of all data collected.

The **Public Relations Division** has two departments: Promotions and Networking. The Promotions Department manages several large projects, such as a monthly newsletter, press releases, development of multimedia presentations, and grant writing. The Networking Department coordinates all communications between EEI and its

constituency, using various forms of communication including the World Wide Web, email, and the postal service.

Creating an Environmental Monitoring Network

A new component of EEI is to create a network of schools and assist them in the development of water quality monitoring projects of their own. The instructions for setting up a water quality monitoring project will be prepared by the Promotions Department of the Public Relations Division. They will design a series of videotapes that will demonstrate a multi-level system, from a simple form of monitoring to a more sophisticated model. This multi-level system of monitoring will allow participation by schools that have limited resources, and by most grade levels.

The network of schools will be organized and maintained by the Networking Department of the Public Relations Division. This will be done using several methods. Students of EEI will create a home page on the Web. The schools will be able to interact with the EEI home page, uploading and downloading data from the network of schools participating in the project. Other schools not able to access the Web can either phone or mail in their data. EEI will organize the data and return to the schools appropriate charts and reports of the data from all the schools in the network.

Several multimedia presentations have been developed to publicize this plan. The presentations include photographic slides, PowerPoint slides, video overhead projections, handouts, and a brochure. EEI students have made presentations at teacher in-service meetings, a countywide civic association meeting, and a statewide technology convention.

Potential impact of EEI

EEI has several educational, social, and environmental goals. The achievement of these goals will have a significant impact on the schools involved as well as the communities they represent.

Educational goals. Writing, computing, research, communicating, and science laboratory skills, all taught in traditional classes, will be reinforced in EEI through relevant learning experiences. The students will experience the value of doing science in their environment and learn that knowledge acquired and applied will make a difference. Through working together in cohesive units and achieving common goals, the students will gain insight into the importance of contributing their individual talents. Multimedia presentations by EEI students will provide a powerful educational experience.

Social goals. The student body of Walker Memorial Junior Academy consists of a mixture of Caucasian (42%), Asian (25.9%), Hispanic (26.4%), and Black (5.7%). The activities of these EEI students within their communities will set a positive image for young people of all ethnic groups.

EEI students will serve as mentors for students in participating schools, assisting in the development of their own environmental monitoring projects. It is the goal of the Environmental Monitoring Network to involve at least 10 schools.

Environmental goals. On the Lake Wales Ridge in Polk and Highlands Counties in Florida, 80 miles from either coast, isolated remnants of ancient shoreline dunes remain as a legacy from an age when the sea very nearly prevailed. These ancient scrubs of Central Florida are the only habitat on Earth for more than 30 species of plants and animals. This is the ecosystem in which EEI operates. Working with local environmental civic groups, schools, and government agencies, EEI strives to increase community awareness and stewardship of our fragile environment.

Note: *The above report was written by the students of Eagle Eye Incorporated and presented by Sandy Fisher of Florida LAKEWATCH.*

Patty Madigan
AmeriCorps Watershed Project, P.O. Box 1697, Mendocino, CA 95460, 707/964-0395, pmad@mcn.org

Engage Yourself in the Elements: Service-Learning

The AmeriCorps Watershed Project is an environmental service-learning partnership between the California Conservation Corps and Adopt-A-Watershed. Service-learning is a method of learning through active participation in thoughtfully organized service that is conducted in a community while meeting the needs and utilizing the assets of that community. The Watershed Project uses a service-learning strategy that combines integrated hands-on science curricula with an innovative implementation model based on school/ community collaboration. Students adopt a local watershed and use it as the focal point for their science curriculum, doing at least three service-learning projects a year. Adult volunteers from a broad range of organizations in the community work closely with the students, lending their expertise in the planning and implementation of the service-learning projects. Secondary students serve as mentors to younger students, and together with a core group of school and community leaders, provide the foundation for sustainable local programs.

The Watershed Project is designed to bring the resources and expertise of communities into the classroom, and out to the local watershed. Teachers need support in identifying, planning, and implementing service-learning projects. AmeriCorps service-learning coordinators oversee the interface between schools and the community and develop science education curricula into a total watershed education model. AmeriCorps Service Crew members act as mentors on field trips and help with restoration projects. The Watershed Project, based in California, is a collaborative model for national service and high quality environmental service-learning. The Adopt-A-Watershed curriculum is currently being piloted in five states besides California.

Service-learning strategy

The service-learning strategy, based on the Adopt-A-Watershed curriculum, has five elements:

1. The science curriculum is applied to the local environment.
2. Students and community volunteers engage in long-term field studies.
3. Students and community identify and perform needed restoration projects.
4. Students inform the public about their watershed service-learning activities.
5. Participants engage in reflection about their watershed experiences.

The Watershed Project further recommends that community/school partnerships build these components into their program:

1. Develop a full K-12 program that teaches science across the curriculum.
2. Include a training element for cross-age tutoring and mentoring activities.
3. Build strong connections between resource professionals and teachers.
4. Model an ethic of service and a spirit of stewardship in all activities.

In 1997 the Watershed Project will serve 20,000 students in over 700 classrooms in more than 250 schools within 12 regions of California. It will involve an average of 50 partners in each region. We are presently working with the Presidio Center for the Environment to develop some criteria and best practices for environmental service-learning. Our goal is to build linkages to strengthen the environmental education community through service-learning partnerships. The service-learning strategy, developed by Adopt-A-Watershed and implemented through the Watershed Project, is a model for community organizations and projects to examine if they are exploring or developing a comprehensive watershed education program.

Communicating Data Through the Digital Highways and Byways

Moderator: **Ken Cooke*,** Kentucky Water Watch
Panelists: **Vera Lubczenko and Michael Cassidy,**
Waterwatch Australia; **Brian Embley,** Stony Brook-Millstone Watershed Association

Vera Lubczenko & Michael Cassidy
Waterwatch Victoria, 6/232 Victoria Parade, East Melbourne, VIC 3002, phone 61-3-94124663, vlubczenko@peg.apc.org

Data Down Under: Data Management, GIS, Internet, and CD-ROM in Waterwatch Australia

As a national community water quality monitoring program, Waterwatch Australia has developed a variety of tools for data management, interpretation, and communication.

These include an offline data entry program, a database, a variety of Internet sites, the use of GIS, and new titles using interactive CD-ROM.

Overview of the Waterwatch Australia program

Waterwatch is a national water quality monitoring program with more than 50,000 people involved across Australia in every state and territory. The Australian Nature Conservation Agency, which coordinates the Waterwatch Australia program, is based in the national capital, Canberra. Each state/ territory has a statewide facilitator, and these people, together with the national facilitator, make up the Waterwatch Australia Steering Committee. A statewide Waterwatch facilitator will support between five and twenty local catchment coordinators, depending on the size of the state and the maturity of the program. (Note: "Catchment" is the Australian term for "watershed.") Local catchment coordinators are employed by a Waterwatch group or local government authority, such as a water authority, and support up to 30 or more schools, Landcare, or community groups working on the ground.

While this structure may appear hierarchical and bureaucratic, it has provided a vital forum for strategic planning and sharing information and ideas, and has catalyzed the development of common tools, materials, and protocols. In this national approach, each state is an equal partner and decisions are made by consensus.

Data flow

The goals of regional or catchment-based Waterwatch groups generally encompass both awareness raising and monitoring of water quality. Monitoring ranges from simple testing to providing high quality data to agencies or sponsoring industries for the purpose of managing waterways. Primarily, data that is generated locally is stored and used locally. However, the capacity to share data between groups, regions, and states is currently being put in place.

The tools

All the data management tools used in Waterwatch have been developed with the recognition that most important of all is local data usage and ownership. This emphasis on delivering local usability as well as a capacity to compare information at a variety of scales has been imperative in building a variety of products. At the national steering committee level, we spent a considerable amount of time in the design phase, which included much lively discussion before reaching consensus on the choice of parameters and units for these products. The result is a system which provides useful outcomes for both a local Waterwatcher and a statewide program. Use of unique catchment coding information has been built into the products. For example, in the Waterwatch database a nationally agreed-upon site-coding system ensures that data sets can ultimately be merged to provide a regional, state, or national overview.

Offline data entry (ODE)

Waterwatch Australia has developed an offline data entry (ODE) program which is based on these nationally agreed-upon parameters and units. It has been developed in both PC-based and Macintosh versions and is primarily seen as a tool which can be used by individuals and groups to enter their own data onto a disk. Because the ODE is very simple in its design, and very intuitive, it does not require extensive training. The ODE has a number of built-in error checks and produces a comma-delimited file which can be uploaded to either a database, a spreadsheet, or, more recently, a database on the Internet. (Waterwatch Victoria is also testing direct submittal of information to the Internet using the ODE.) The rationale for allowing Waterwatchers to enter their own data is to automate the process and alleviate the need for the local coordinators to do all the data entry, thus freeing their time for data checking. Waterwatchers can send their data to a local coordinator on disk, email the information, or, as a last resort, submit paper copies of their data.

Access database

The Waterwatch database, which is now being tested, is designed as a tool for local groups to convert data to information to meet local goals. It uses a run-time version of Microsoft Access (a relational database). Training of Waterwatch coordinators in the use of the database takes about three hours. Training assumes only a low level of familiarity with computers and takes trainees to the stage where they can enter their own data, manipulate data, and produce a variety of reports, tables, and graphs. The use of unique site

codes within each state/territory ensures that local databases can be merged. Waterwatch Victoria is currently investigating use of an Access database on its Internet site.

GIS

Data from the Waterwatch (Access) database can be exported to a GIS environment to produce a variety of maps, thereby enriching the value of monitoring work being done by Waterwatch groups. GIS in the Waterwatch program is being used for "State of the Environment" reporting, for location of monitoring sites, in "marrying" scientifically collected data with community-collected data, and to incorporate other natural resource information to provide a total catchment overview.

Internet

Many of the state/territory Waterwatch programs have developed or are in the process of developing their own Internet sites. With Waterwatch Australia providing a parent Internet site to link all state/territory sites, a very useful communication tool is now in place for use by all Australian Waterwatchers. Waterwatch Victoria's Internet site uses animation and attractive design and provides an innovative forum area that allows anyone to post messages and reply in a very easy way. A series of projects has also been set up in this forum area to encourage greater use of telecommunications, particularly in schools. Development and use of a variety of templates on the Internet site ensures that the site

can be regularly updated by Waterwatch coordinators without the need to know any HTML (the language of Internet programming). The URLs (addresses) for our Internet sites are as follows:

- Waterwatch Australia: http://www.waterwatch.org.au
- Waterwatch Victoria: http://www.vic.waterwatch.org.au
- Waterwatch South Australia: http://www.sa.waterwatch.org.au/
- Waterwatch New South Wales (called Streamwatch in this state): http://www.streamwatch.org.au

CD-ROMs

The New South Wales Department of Land and Water Conservation, in collaboration with Woolongong University, has recently produced an interactive CD-ROM entitled "Exploring the Nardoo." This innovative CD uses an imaginary inland river environment to allow the user to explore the ecology of four physical regions across four time zones. It uses a comprehensive and captivating set of multimedia resources. You can also use simulators, make measurements in the river, read newspaper articles, listen to audio reports, view video reports, and browse the information in the filing cabinet. This type of approach provides a very useful model for investigating catchment issues without being site-specific. Although not commissioned by the Waterwatch program, it is being promoted as another useful resource to supplement our programs. A variety of other interactive CD-ROMs are planned within the Waterwatch Australia program.

Although we are aware that none of the data management products we've developed is perfect, we believe a fundamental principle has been the ability to share and develop these tools using a national approach. The result is that we can deliver data at a variety of scales: local, regional, and national.

Brian R. Embley
Stony Brook-Millstone Watershed Association, 31 Titus Mill Road, Pennington, NJ 08534, 609/737-3735

Displaying Your Data and Beyond

Over the past few years, volunteer monitoring programs have been inundated with technological buzzwords like the Internet, World Wide Web, CD-ROM, email, RDBMS, and so on. Each new tool is touted as the latest revolution in data management and a necessity for any organization that crunches large datasets and seeks to provide its data to the general public. All these acronyms and technological overkill have many volunteer monitoring program managers feeling dizzy. This presentation is to designed to demonstrate how a small environmental nonprofit organization need not be intimidated by technology but can use one of the hottest buzzwords around-"GIS," or geographic information system-to enhance a monitoring program.

By now you have heard how wonderful geographic information systems are but what can a GIS do for your volunteer monitoring program? The heart of a GIS is its unique ability to integrate tabular data, like your water quality database, with spatial data, like the features on a map. A multi-talented system, GIS can be used to create pretty maps with your existing water quality data and also to study the relationship between your water quality findings and surrounding geographic features such as land use or proposed development schemes. A resulting series of colorful maps can show decision makers and the public how these complex relationships work. Sound intimidating? Well, our environmental nonprofit organization with its own volunteer water quality monitoring program is doing just that. *If we can do it, so can you.*

The Stony Brook-Millstone Watershed Association (SBMWA) is a private, nonprofit environmental organization in central New Jersey. Since its birth back in 1949, the Watershed Association has been supported largely by individual membership dues in our efforts to enhance the quality of the natural environment in the 285-square-mile area drained by Stony Brook and the Millstone River. To that end, a volunteer water quality monitoring program, StreamWatch, was started in 1992 and has now grown to include 180 volunteers conducting chemical and physical water sampling, performing visual assessments of waterways and their riparian zones, and, most recently, sampling macroinvertebrate populations. The continued success of the StreamWatch Program has resulted in reams of data being spit out by the database computer and assembled twice annually into *The StreamWatch Report*. This report, which is distributed to regulators and made available to the general public, contains valuable water quality information, yet in the past has been too technical for nonscientists to comprehend.

Recently, the SBMWA began to utilize the power of its existing desktop geographic information system to integrate the raw water quality data into colorful, simple, and easy-to-understand maps. The GIS, which was originally intended for studies of land use and land cover in the region, is a natural tool for putting the data into a friendly format and also promises to be invaluable in applying the data to future studies of land use vs. water quality. Assembling and operating such a system is not as difficult as you might think, as long as the following points are kept in mind.

Every geographic information system is comprised of four essential elements: software, data, a person to operate the system, and hardware. Each is as important as the others, and if one is neglected the effectiveness of the system will be greatly compromised.

GIS software has come to the desktop computer in the past couple of years and is easy enough for almost anyone to use. The package used by the SBMWA is called ArcView 2.1 by Environmental Systems Research Institute (ESRI), Inc., which costs under $1,000 and runs in Windows or on a Macintosh. ArcView 2.1 uses existing spatial data in a digital format to be stored, analyzed, and displayed. The SBMWA acquired its copy for free, through a joint grant program between ESRI and the NJ Department of Environmental Protection (NJDEP). Recipients of the free software entered into a data-sharing agreement with NJDEP in which digital GIS data would be provided to the

organization, at minimal or no cost, from the NJDEP's existing databanks. In turn, any original data developed by the organization would also be shared with the NJDEP.

Development of high quality GIS data is often the most lengthy and expensive component of building a GIS. Many data layers-such as roads, streams, lakes, political and watershed boundaries, and land use-provide the backdrop for your water quality data and are essential for analyses.

The third component is a trained person to manage and operate the system. Training is essential for this person and can be found in classes taught by ESRI or at colleges and universities. Management must allow the appointed operator time and resources to develop the system. A GIS is never "completed" but instead evolves over time and becomes more powerful with the accumulation of expertise.

Finally, you need a computer to run the entire system on. Few volunteer monitoring programs have the necessary high-end desktop machines to sufficiently power a GIS. For a few thousand dollars, such a machine can be purchased and a little creativity usually can find a funding source for this equipment. Such is the case with the SBMWA, which received funds through a partnership with a local educational institution.

Once the software, hardware, GIS data layers, and training are assembled, you can start to work. First, you will want to use your GIS data to produce a base map on which most of your future work will begin.

Now that you have your GIS data organized you can begin to integrate your water quality monitoring data that your volunteers have diligently been collecting. Assuming your water quality data is already in a computer database, all you need is to identify the correct geographic feature to link to your data. In the SBMWA's case, and most likely yours as well, sampling sites are that logical feature. A simple process of on-screen digitizing can be used in ArcView 2.1 to make a data layer of your sites; a more accurate method is to pinpoint the sites in the field with a global positioning system (GPS) receiver. SBMWA has completed the former, and will begin the latter upon arrival of our new GPS receiver. Some universities, colleges, or agencies are willing to provide GPS training and the use of a receiver. With your sites now a layer in your GIS database, it is a couple of simple points and clicks of your mouse in ArcView to link the sites and your water quality data together.

At this point you are ready to use your data! At the SBMWA we first performed some calculations on our water quality data to allow us to divide our sampling sites into categories based on overall water quality. The GIS allows the categories to be easily changed if need be and produces colorful, understand-at-a-glance maps. The Watershed Association is now using its GIS to perform stream corridor studies and is looking to future land use/water quality analyses.

An important point to remember when implementing your own GIS: Just because you are new to the world of GIS does not mean that you are alone. Many agencies and

universities (remember where you got your GIS data layers from!) have GIS professionals who are more than willing to answer your questions. In New Jersey, so many environmental nonprofits are using GIS that we formed our own user's group to support one another. Cultivate partnerships with others, whether it is for equipment, expertise, or both. As your own system evolves and you become more and more competent, you may find others looking to you for guidance in putting GIS to work for them. In the beginning it is natural to feel intimidated or overwhelmed, but after a software training class and some time to play with your system, you will be making maps before you know it. Remember, if we did it, so can you.

CONCURRENT SESSION 6

Innovative Data Presentation and Reporting Techniques

Workshop Leaders: Jerry Schoen, Massachusetts Water Watch Partnership; Robert Craycraft, University of New Hampshire Cooperative Extension Jerry Schoen Massachusetts Water Watch Partnership, Blaisdell House, University of Massachusetts, Amherst, MA 01003, 413/545-5532 Robert Craycraft New Hampshire Lakes Lay Monitoring Program, University of New Hampshire Cooperative Extension, Pettee Hall, 55 College Rd., Durham, NH 03824, 603/862-3848

Part I (presented by Jerry Schoen)

The objective of this session is to present and describe several examples of innovative data presentation methods and to provide an opportunity for session participants to discuss their experiences with other imaginative means of reporting data. (Note: For additional useful information on outreach concepts and strategies, the reader is referred to Session 2, "Getting in Step: A Pathway to Effective Outreach in Your Watershed," and Session 4, "Dealing with Your Data, Part 2.")

Objectives of data presentation

We suggest that groups developing data presentation campaigns consider five objectives of data presentation:

1. Educate your audience about watershed ecology.
2. Inform your audience of existing conditions.
3. Suggest or point out causes of conditions and sources of degradation.
4. Suggest solutions to problems that cause conditions.
5. Motivate people to participate in developing and implementing solutions.

For each audience you target, for each presentation you make or report you produce, you will try to accomplish one or more of these objectives. Which you shoot for depends on the level of expertise of your audience, their interests and viewpoints, your own program goals, and a number of other factors. For instance, unless your audience possesses some understanding of watershed ecology, it may prove difficult to get them to care about nutrients in your lake, maintaining riparian trees, etc. In this case, you might want to accompany your graphs of nutrient levels with schematics of the hydrologic cycle, photos of farm runoff, and so forth.

Note that this list of objectives demonstrates something of a trend-from communication that is primarily intellectual or informative to communication that is more emotional or visceral. Motivational presentations often aim for a gut-level response. By including a bit of positive or negative reinforcement in your presentations, you may strike a chord that a more scholarly approach does not sound.

Before you pitch your data to an audience, consider what they know and what is likely to motivate them. Then make your pitch in a way that accomplishes the appropriate education or advocacy objectives. The sidebar on page 77, "Data Presentations That Meet the Five Objectives," provides several examples of presentations that target each objective.

What constitutes "innovative" data presentation?

We've set the bar pretty low in our definition of "innovation" in data presentation, primarily because our experience and research has shown that too many groups do little or nothing with the data they collect. Many are content with a written report that serves for all their intended audiences. With this in mind, we view innovation as any method or approach that you don"t normally use, or any method that recognizes the five objectives mentioned above and designs the presentation to meet the appropriate objectives. Innovation can also be:

- Portraying unusual parameters or an interesting mix of parameters. Example: The Charles River Watershed Association uses a bar graph that portrays groundwater withdrawals in the basin on top of monthly streamflow averages for the river. The graph clearly shows that in summer months, as much as 50% of the potential streamflow for the river is being withdrawn. In presenting this graph, the Association manages to inform people and motivate them at the same time.
- Using unusual media or an interesting mix of media. Examples include (1) a T-shirt that shows how sensitive surface waters in each town in Massachusetts are to impacts from acid rain; (2) displaying aquatic plants submersed in plastic bottles alongside maps that show macrophyte coverage of your lake; (3) using photos of eroded banks alongside turbidity or macroinvertebrate data.
- Accompanying your data with accessories, like the aquatic plant and photo examples above, or actual specimens of embedded stream rocks, aquatic insects in an aquarium, etc.

- Presenting or discussing your results at different venues-for example, displaying exhibits at environmental fairs, placing Secchi data charts at boat launching ramps or bait stores, or holding community clean water forums.

Part II (presented by Robert Craycraft)

Water quality data are all too often portrayed as a series of parameters that illustrate a water body"s condition, such as its trophic status. However, one might ask, "What does this mean?"-a question that arises particularly when working with a lay audience. If one is to generate interest in the volunteer monitoring effort and sustain the endeavor, a link must be made between the collected data and the resource at risk.

In the case of Squam Lake, New Hampshire, an in-lake habitat assessment was performed to identify critical wildlife habitats that warranted protection. These included common loon nesting sites, smelt streams, salmon habitat, and other important habitats. By seeing photos of the creatures and their habitat as well as water quality data, the public gets a better sense of the connection between in-lake resources and the potential demise of these habitats through water quality degradation.

Data Presentations That Meet the Five Objectives

Objective 1: Educate your audience about watershed ecology.

Examples:

- Graph of dissolved oxygen values superimposed on range of DO tolerances for cold- and warm-water fish species, as found in the scientific literature.
- Graph showing complementary relationship between water clarity and trophic status.
- Pie charts of macroinvertebrate samples, presented with schematics and maps to show how communities shift from shredders to collectors as stream order increases.

Objective 2: Inform audience of existing conditions in water body.

Examples:

- Annual report comparing monthly nutrient levels at three sites on your lake.
- Newsletter that lists levels of 8 different parameters from your most recent sampling.

Objective 3: Point out causes of conditions and sources of degradation.

Examples:

- Pictures of cows in a stream, portrayed next to graphs of DO or bacteria data.
- Map showing land use categories in areas upstream of your sample sites.
- Graph showing coliform and/or turbidity levels, superimposed with rainfall data.
- Photos, maps, and data charts comparing pollution levels at two sites that bracket a factory.
- Map and chart showing elevated stream temperatures in reaches that lack riparian vegetation.
- Turbidity data that include site and date, linking a construction activity, rainfall, and muddy water.

Objective 4: Suggest solutions to problems.

Examples:

- Data that show effects of BMPs ("best management practices"), such as fencing cows away from streams or upgrading septic systems. Depending on

the BMP, these can be "before and after" or "above and below" comparisons.

Objective 5: Motivate people to participate in developing and implementing solutions.

Examples:

- Photos of dead fish in a stream, presented alongside your DO and temperature data.
- Photos or videos of people recreating in a restored waterway ("This could be us!").
- Historical trend data, showing big improvements in the last decade ("We're almost there!").
- Oral presentations by school children, describing both their sampling results and their disgust with the conditions they find.
- An acid rain display that cites figures indicating more Americans die of pollution-caused respiratory diseases each year than were killed during the entire Vietnam war.

Temperature and dissolved oxygen data are commonly collected among volunteer monitoring programs and can dictate what types of fish species will survive in the water body. These parameters can be presented in a manner that emphasizes their influence on a water body"s fishery. You can use cartoons and catchy visuals to make the link in a simple, humorous fashion.

The Vermont Department of Environmental Protection"s volunteer monitoring program built sturdy wooden signs illustrating weekly changes in water clarity (Secchi disk depth). Screw-in pegs recorded the weekly changes, and the signs were displayed in public areas such as boat launches and store windows-places where resource users are likely to congregate. Volunteer monitors in the New Hampshire Lakes Lay Monitoring Program have posted weekly temperature profiles at local marinas and bait shops. Visiting anglers use the data to help find the fish, and at the same time they learn about the activities of volunteer monitors.

Here are a few additional examples from various volunteer monitoring groups:

- An exhibit that displays aquatic plants submerged in alcohol in clear plastic jars. Features: Uses actual specimens; eye-catching. Good for lake association meetings and festivals.
- The "Bugquarium": a four-compartment aquarium used to display live macroinvertebrate specimens. Features: Eye-catching; interactive; good for use at festivals and other public and school events. By arranging the bugs in different compartments, it can be used to teach several concepts: general watershed ecology, the river continuum concept, habitat and water quality requirements of bugs, taxonomic differences, etc. Works well in conjunction with data graphs.

- Acid rain poster developed by the Sierra Club. Features: Good mix of photos, graphs, and text to meet several data presentation objectives (educate, inform, and motivate audiences); illustrates importance of marketing the exhibit once it"s produced (the Sierra Club hired an intern to book the exhibit at museums, fairs, and other events throughout the Northeast). When posters are created in "modular" fashion (by using Velcro to attach text, photos and charts to a backboard), it"s easy to rearrange them for later use in different settings and as new data are obtained.

Monitoring Macroinvertebrates

Moderator: **Geoff Dates,** River Watch Network
Presenters: **Geoff Dates; Connie Fortin,** Hennepin County Conservation District; **Denise Stoeckel,** Illinois Natural History Survey

Geoff Dates
River Watch Network, 153 State St., Montpelier, VT 05602, 802/223-3840

An Introduction to Monitoring Macroinvertebrates in Rivers

What are they?

Benthic macroinvertebrates are aquatic animals without backbones that spend at least a part of their life cycle on the river bottom. Examples include aquatic insects-such as mayflies, stoneflies, caddisflies, midges, and beetles-as well as crayfish, worms, clams, and snails. Most hatch from eggs, and mature from larvae to adults. Most of the insects spend their larval phase on the river bottom and, after a few weeks to several years, emerge as winged adults. The aquatic beetles, true bugs, and other groups remain in the water as adults. Macroinvertebrates we collect from the river bottom are either aquatic larvae or adults.

Where are they found?

They inhabit all types of running water habitats from rushing mountain streams with rocky bottoms to sluggish, meandering rivers with sand and mud bottoms. They are found in three main habitat types:

Riffles: Shallow (<2 feet), fast-moving (0.5-2.0 feet/second) reaches with cobble bottoms.

Runs: Deeper (>2 feet), slower-moving reaches with sandy and gravelly bottoms.

Pools: Deep, slow-moving reaches with muddy bottoms.

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. A variety of food is also found in riffles: leaves and other large organic particles on the bottom, smaller decomposed bits of food or live microorganisms carried in the water column, and algal communities growing on the cobbles.

Why are they used to monitor rivers?

Benthic macroinvertebrate communities are used to assess the river"s ecological integrity-that is, to answer the question, Is the river ecosystem healthy and functioning properly? They are good indicators primarily because they are an integral part of the river ecosystem and reflect its physical, chemical, and biological conditions and processes.

For example, benthic macroinvertebrates are essential to the river"s food web. They process food in four main ways and, based on their feeding strategy, can be separated into 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 from the stream bottom (gathering collectors).

Scrapers/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.

Knowing which feeding groups are present tells us something about the nature of the food source in the stream. Food might be produced naturally in the stream (via photosynthesis) or out of the stream (dropping from riparian vegetation). It may also be affected by human activities that add organic matter to the stream (e.g., sewage) or remove it (e.g., by removing streamside vegetation).

Other reasons that benthic macroinvertebrate communities are good indicators include:

- They can"t escape pollution, so they integrate the effects of short-term pollution events and long-term water quality.
- They can tell us things about the river that other monitoring can"t.
- They are relatively easy to sample.

What do benthic communities tell us about the river?

The macroinvertebrate community can be used to evaluate the biological responses to pollution as well as physical habitat changes. This response can be used to compare conditions upstream to downstream, above and below pollution sources, from season to season, and from year to year.

The response of the benthic macroinvertebrate community to human impacts is measured in a number of ways. For each of these measures, data summaries known as *metrics* are calculated. Each tells us something different 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 (taxa) 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 habitat diversity and food (quantity and different types), and a 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 seriously degraded. Caddisflies contain many taxa that are sensitive to pollution, but also one common taxon (certain genera within the family Hydropsychidae) which is 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 (see section above). Functional feeding groups are useful in determining the food sources in a river. Since human activities affect these food sources, the functional feeding groups that are present can indicate impacts. For example, if all functional feeding groups are well represented this indicates a diversity of food sources-fine particulate organic matter in the water column, growth of small algal communities on rocks, coarse particulate organic on the bottom, etc. If collectors dominate, it may indicate an overload of organic material in the water column or settled on the river bottom. If filtering collectors dominate, it means that this material is fine particles-well-decomposed sewage, manure, or processed coarser material from upstream. If gathering collectors

dominate, it could mean that poorly decomposed sewage or animal manure or other organic material from upstream is deposited on the 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).

Comparison to Reference Conditions: the percent comparability of the community collected at the monitoring site to an actual community collected at an ecoregional reference site or to a theoretical "model" community established by state or regional biologists. In either case, the results for your samples are compared to those for a community that would be expected in the "least impaired" conditions in a region. This is usually calculated by scoring the results from a number of metrics, summing these scores, and dividing this result by the score for the reference site or condition. This comparison to least-impaired conditions in a region summarizes many of the factors described above into a single "impairment" score. The lower the percent comparability, the more impaired the site is.

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

How benthic macroinvertebrates are monitored

Benthic macroinvertebrate monitoring involves a number of steps:

1. Collecting samples
2. Processing the samples
3. Identifying the critters: to what taxonomic level
4. Summarizing and analyzing the data

Each of the steps is briefly discussed below.

I. **Collecting samples:**
   A. **Where to collect.** Benthic macroinvertebrates are found in riffles, runs, pools, leaf packs, and woody debris habitats. So the first question is: Which habitats should you sample? Considerations include:
      - Which habitats are present?
      - Which habitats tell you what you want to know?
      - Will you sample a single habitat or multiple habitats?
      - What are your sampling capabilities?

The focus of most benthic macroinvertebrate collection is riffle habitats. These are defined as follows:

- Well-scoured predominantly rubble/cobble (2-10" rocks).
- Current velocity of 0.5 - 2.5 feet per second
- Depth of 0.5 - 2.0 feet

Once you've selected the types of habitats you will monitor, you then need to find reaches that have these habitats and locate sites that will answer your question. In general, there are two main types of benthic macroinvertebrate studies. Each has its own set of site selection criteria.

The river biological characterization study is intended to establish the presence and range of the macroinvertebrate communities in an entire watershed area in order to evaluate the changes in these communities within a river system. The results are compared with a reference site that has been selected to represent the best attainable conditions in a region. The following types of sites should be considered to characterize a watershed:

- Different sizes or drainage areas
- Different altitudes
- Different habitat types
- Differing predominant land use (urban, agricultural, forested)
- Receiving point source discharges
- Receiving nonpoint pollution
- Reference sites representing the best attainable macroinvertebrate habitat conditions in your area for each type of river reach (e.g., headwaters, mid-reach, larger rivers). Consult with an experienced aquatic biologist who is familiar with the characteristics of the rivers in your area. The sites need not be on your river, but should have similar habitat characteristics. Many state agencies have already identified these sites.

The impact assessment study evaluates the effect of a human alteration of the river (e.g., pollution discharge, dam, etc.) on the organisms living there. This type of survey is intended to establish the changes in the biological community due solely to the alteration. The following types of sites should be selected:

Reference or control site: This site is located immediately upstream of any potential impact from the alteration being evaluated. The benthic macroinvertebrate community at this site will be considered as a reference to which the downstream communities will be compared.

Impact site: One station should be located immediately downstream of the alteration at the point where the impact is completely integrated with the river water.

Recovery site: This site is located downstream of the potential impact from the alteration being evaluated, where the river has at least partially recovered from the impact.

B. **How to collect.** Sampling can either be qualitative or quantitative. *Quantitative sampling* standardizes the level of sampling effort, either by standardizing the area of collection and/or the time involved in the collection. Qualitative sampling does not standardize the level of effort.

There are many types of sampling devices, but the two most commonly used are collection nets and artificial substrates. Nets can be either qualitative or quantitative depending on the collection technique. Artificial substrates are quantitative if left out for a standard period of time.

Nets are used to catch organisms which are dislodged from the river bottom immediately upstream. The organisms are swept into the net by the current. This technique is best suited for use in riffle habitats. Metal frame nets and seines are the two most common types.

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,* which consist of tiles stacked with spacers on an aluminum turnbuckle, and *rock baskets,* which 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 yields more repeatable samples than the kick-seine method because it helps eliminate variations in sampling techniques and it standardizes the type

and area of macroinvertebrate habitat among sites. This is particularly important in impact assessment surveys, where upstream and downstream sites will be compared. Artificial substrates also may enable sample collection in areas that do not lend themselves to the use of nets. For example, they can be suspended in the water column in deep rivers with 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. Another potential problem is that artificial substrates 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, it represents an ideal physical habitat, which may not really exist at the site. Therefore, the organisms that colonize it might not be able to live at the site (due to heavy sedimentation, for example).

A final consideration is how many samples you will collect at each site. *Replicate samples* are multiple samples collected at the same site at different spots in the riffle. *Composite replicates* are samples collected from multiple habitats within a riffle, and combined into one sample. The most representative samples are composite replicates.

II. Processing samples

Once the samples are collected, they may be processed and identified either in the field or in the lab. Processing samples involves picking a subsample and identifying the organisms to some taxonomic level: order, family, genus, or species. *Field processing* usually involves identification to order and some families. *Lab processing* involves preservation of the sample or subsample and bringing it to a lab for later identification, usually to family and some genera or species.

III. Identifying the critters

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 non-biologist. Family level taxonomy involves knowledge of some fairly subtle differences in body characteristics, and requires the availability, at some point, of an aquatic biologist or entomologist to verify the identification.

The sensitivity of the study refers to its capability to detect changes in the community from site to site. Sometimes these changes are subtle. For example,

there are families within the mayflies and caddisflies that are very sensitive to pollution, and others that are fairly tolerant. 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* for each organism. So identification to family provides additional information about the pollution sensitivity of the community.

IV. Summarizing and analyzing the data

After you"ve identified the critters, you can use the metrics discussed below to characterize your benthic macroinvertebrate samples in terms of abundance, diversity, pollution tolerance, composition, how they compare with each other, and how they compare with a theoretical "model" or actual reference community. The metrics you are able to use will depend on whether you"ve collected qualitative or quantitative samples and the level of taxonomy.

Methods options

Benthic macroinvertebrate monitoring methods are "packages" of site selection, collection, sample processing, and data analysis techniques. They are mixed and matched in a bewildering variety of ways depending on who designed the method. These methods form a continuum of complexity and sophistication, from simple field assessments used for education, awareness, and screening to rigorous and intensive surveys used for enforcement.

As reference points, here are four methods that fall at various points on that continuum:

A. Streamside Assessment or Survey
B. Semi-Quantitative Collection: Level 1
C. Semi-Quantitative Collection: Level 2
D. Quantitative Collection: Artificial Substrates

In selecting a method, consider the following:

- The specific question you"re trying to answer about the river
- Who you expect will use your data and for what
- Your data quality goals: how representative, precise, and sensitive to change your method must be
- Your human and financial resources
- The types of habitats present in your river

In general, the more rigorous the method, the more options for data uses you have and the higher the level of precision and sensitivity to change. Note, however, that artificial substrates may not detect some changes as readily as net collection methods. That"s

because they create artificial habitat that might mask the impacts of degradation of the "native" habitat. The more rigorous methods require more human and financial resources.

Ultimately, the method that works best for you balances these practical and scientific considerations. And it"s not all or nothing. For example, you can use the streamside survey as a screening method to help you identify sites for more intensive work. You can start simple and get more complex as your data use and quality goals change. Regardless, one size does not fit all and you should select a method that"s appropriate for your unique situation.

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Connie Fortin

Hennepin Conservation District, 10801 Wayzata Blvd. Suite 240, Minnetonka, MN 55305, 612/544-8572, HCD@SKYPOINT.COM

Macroinvertebrate Education and Monitoring: Producing Quality Results

This paper describes the Hennepin Soil and Water Conservation District"s macroinvertebrate education and monitoring program. The Hennepin Conservation District (HCD), located near Minneapolis, Minnesota, is a special-purpose local unit of

government with staff having expertise in soil and water resources. Hennepin County is primarily an urban area. HCD is coordinating a macroinvertebrate monitoring program for the creeks of Hennepin County. The program"s purpose is to provide hands-on environmental education opportunities for high school and college students and to gather information on the creeks in our county.

Program goals

Our short-term goal (1995-1997) is to get schools involved and interested in the program. We are promoting the program through local newspapers, television, and educational brochures and by attending community events and speaking to community groups.

Our long-term goal (1997-1999) is to obtain scientific quality data on the creeks and streams in Hennepin County. We expect the high schools to provide scientific quality data, to network among themselves, and to share and compare data. As part of the project, we hope to give high school students an understanding of nonpoint source pollution and how it impacts the creeks. Although we are interested in education, if this effort proves that high schools and colleges cannot produce usable data it is likely that the focus of this program will change.

Methods

Our program uses high school and college students to perform habitat assessment and macroinvertebrate sampling and identification. HCD supplies the schools with all the neces- sary equipment. Kick nets are used to collect three replicate invertebrate samples per site. Each school performs identification to the family level. We have developed a spreadsheet for schools to enter the results of their identification. The spreadsheet will calculate diversity, abundance, and water quality rating. This sampling method was obtained from the River Watch Network Benthic Macroinvertebrate Monitoring Manual.

Teacher training

Effective teacher training is critical to a successful program. We have discovered that teacher training, both field and classroom, must be hands-on and that teachers should go through every step that they will expect their students to perform. HCD conducts a four-hour training session twice a year. Our experience has shown us that teachers want to be invited to training sessions even if they have already been trained. The training session gives them additional confidence for working with their students as well as an opportunity to network with other teachers involved with this project. An excellent training tool is to give each teacher a vial with unidentified invertebrates in it and have them go through the exercise of identifying the organisms to the family level, labeling the vials, and preserving the specimen. This also starts the school"s reference set of organisms, which is very useful to the students.

Site selection and sampling

Site selection should take into account a variety of factors. A strictly scientific approach would be to locate riffles in stream segments that we want analyzed. Our current approach also takes into account some human factors. Thus we look for riffle areas that provide safe access for students and are located in a stream segment that we want analyzed within a watershed or local community that provides financial support for this program. We try to assign sample sites as close to the participating high schools as possible. For all of our high schools this still requires transportation, which is arranged and paid for by the schools.

Sample collection is the students" first task. We prefer to gather samples prior to habitat assessment so the sampling area will not be disturbed. Students measure off a 200-foot segment within which the study will occur. Sample collection involves walking upstream to riffle area, then using the kick net to obtain three separate samples from the creek bottom.

The schools perform habitat assessments using River Watch Network habitat assessment data sheets. Information is collected on types of bank vegetation, river depth, temperature, velocity, adjacent land use, and river bottom composition, just to name a few. From our experience, habitat assessment is not a very exacting process. It has room for interpretation. We notice that the schools" results may vary greatly from one sample session to the next, even given the same sample site.

Processing and identification

Processing the samples is a classroom activity. It involves emptying the contents of the sample into a gridded tray, selecting random squares of the tray, and removing all organisms found in one square before proceeding to the next square. This is repeated until at least 100 organisms are selected. You can imagine that if you asked students to select 100 organisms from the entire tray, chances are they would select the 100 largest invertebrates. By random subsampling you are more likely to get a representative sample.

Identification of the invertebrates is a slow, precise activity. This is the area where many teachers lack experience and confidence, and unfortunately is the area where students find it most difficult to concentrate. Having a reference set of invertebrates available gives the teachers more confidence and provides a comparison tool for the students. Quality control is very important for us at this stage. HCD collects the identified organisms from the schools at the end of each sampling period. This allows us to review the students" work to see if the results are accurate. This also provides us an opportunity to speak to each teacher individually and answer any questions they may have.

Data analysis

Analysis of the results takes place when the schools submit their results to HCD. HCD provides each school with a spreadsheet for entering their results. The schools are asked to enter the organism count by family and per sample. The spreadsheet will calculate all the metrics the schools are interested in, including the water quality rating. However,

even though the schools have been asked to use this spreadsheet, so far they seem uncomfortable reporting their results electronically and seem to prefer to use paper. HCD will continue to encourage schools to use the spreadsheets and Internet to communicate with HCD and with other schools. HCD compiles the results and reports them to the participating high schools, watershed management organizations, and other interested agencies.

Program improvement

Program improvement is an ongoing concern for HCD. We send surveys to the participating high schools twice a year. In addition we talk to the teachers as often as possible to see what their ideas and concerns are. This spring HCD formed a benthic macroinvertebrate steering committee comprised of educators, HCD staff, a DNR aquatic entomologist, and other interested agencies. This committee meets twice a year to review the progress of the program.

As we work with the high schools it is important to keep in mind that the easiest way to get kids excited about science is to get their teachers excited about science.

Denise B. Stoeckel, Ph.D.
Illinois Natural History Survey, Forbes Biological Station, P.O. Box 590, Havana, IL 62644, 309/543-3950

The Development of Macroinvertebrate Collection Procedures for the Illinois RiverWatch Network

The Illinois RiverWatch Network was established in April 1993 as a partnership among Illinois citizens to monitor, restore, and protect the state"s rivers and streams, and to complement the Illinois Critical Trends Assessment Project (CTAP), the first comprehensive assessment of the state"s environment. One of the key findings of CTAP"s 1994 report was that insufficient data were available to adequately assess the quality of Illinois" aquatic ecosystems. By establishing a statewide volunteer stream monitoring network, Illinois will be able to monitor long-term ecological trends and obtain information on how Illinois stream ecosystems are changing, the rate of change, and factors causing change.

The goals of the Illinois RiverWatch Network are to provide consistent high-quality data that can be used by scientists; to measure how the quality of stream ecosystems is changing over time; to educate and inform Illinois citizens about the ecology and importance of Illinois streams; and to provide an opportunity for Illinois citizens to become involved in protecting the health of local streams. My goal as the technical advisor/quality assurance officer of the Network has been to design a statewide volunteer stream monitoring program that will be found acceptable by the scientific community of Illinois. Before I designed the sampling program I had to first determine who wanted this data and how were they going to use it. I realized that the program would serve no use if volunteers were collecting data that no state organization would use.

Data users' needs

After several telephone calls, I found that the Illinois Department of Natural Resources (IDNR), Illinois Natural History Survey (INHS), and Illinois Environmental Protection Agency (IEPA) were interested in using the data collected by our volunteers. The IDNR wanted data that could detect trends in macroinvertebrate communities, to complement the CTAP program. They also wanted information that would complement their fish data because macroinvertebrates are important as a food resource for fish and streams are fish habitat. INHS wanted information on the distribution of stream macroinvertebrates and community composition. IEPA wanted stream quality information on streams they were not monitoring due to limited resources. (Currently, IEPA has resources to monitor approximately 45% of Illinois stream miles each year.) Where IEPA and the Network monitor the same streams, volunteer stream monitoring will complement the IEPA estimates for streams or stream reaches.

Volunteer monitoring in other states

Because I was planning a statewide volunteer stream monitoring program, I wanted to know if other states were currently running similar programs. I called programs in Indiana, Wisconsin, Missouri, Kentucky, Texas, Maryland, Ohio, and Connecticut. Through these telephone calls I found that most of the volunteer stream monitoring programs conducted water chemistry testing (i.e., DO, pH, turbidity). However, some were beginning to develop, or were in the first year of, a macroinvertebrate program. If the group collected macroinvertebrates, they used, or modified, the Izaak Walton League method; that is, they had a purely qualitative program, and identified the macroinvertebrates to the taxonomic level of order. Few, if any, identified macroinvertebrates to family level. The age of the volunteers participating in these programs ranged from children to adults.

After determining Illinois" data needs, I concluded that most states did not possess a macroinvertebrate sampling program that would satisfy these needs. I began to wonder if the development of a volunteer program that identified macroinvertebrates would be possible. I searched for scientific papers on the topic and found two that studied the accuracy of volunteer data collection. The first paper, by Mark A. Dilley (1990), compared volunteers of the Ohio Department of Natural Resources (ODNR) Scenic Rivers Stream Quality Monitoring Program to Ohio Environmental Protection Agency (OEPA) personnel. He ran comparisons of both groups conducting similar procedures; he then compared volunteer data collected via the Izaak Walton League method to data collected by OEPA personnel following state stream assessment procedures. Volunteers collected from riffle areas only, whereas OEPA personnel sampled from several stream habitats and used state-specific assessment protocols. Dilley found that the volunteer data did not necessarily agree with OEPA"s quantitative stream quality ratings of GOOD, FAIR, and POOR. However, the volunteer data did agree to some extent with OEPA"s qualitative ratings of attainment and non-attainment. Another paper, by Penrose and Call (1995), compared volunteer-collected data to state personnel-collected data in South Carolina. Volunteers in South Carolina were trained to collect macroinvertebrates

following modified state procedures, and to identify macroinvertebrates to the taxonomic level of family. In this study, volunteer data did not totally agree with data collected by state personnel because of the insensitivity of the family-level biotic index. Both these papers stated that volunteer stream monitoring programs could collect useful data that provided information on the general condition of a stream, though not necessarily on subtle changes in stream quality. Both papers also emphasized that training of volunteers is important to the quality of the program. From this I concluded that the success of the Illinois RiverWatch Network would be dependent upon the quality of training that the volunteers received.

Designing a program for Illinois

After learning what volunteer stream monitoring programs across the country had done, I had to consider any unique characteristics the state of Illinois possessed that would influence a statewide sampling program. First, not all streams in Illinois have rocky bottoms. This meant that a monitoring program that involved sampling from riffles only, like most volunteer stream monitoring programs, was not adequate. A sampling program had to be designed that could be used on all types of streams in Illinois (i.e., rocky, sandy bottom, and hardpan). The IEPA Facility Related Survey and U.S. EPA Rapid Bioassessment Protocols consisted of sampling from every possible macroinvertebrate habitat within a stream site. After consultation with INHS aquatic ecologists, we decided to have volunteers sample from the "two most diverse macroinvertebrate habitats" in a 200-ft site. This way volunteers would be collecting for the best possible sample of pollution-intolerant organisms in their stream site. The reduction in the number of habitats sampled would shorten the time the volunteer would spend in the field and reduce the number of organisms that a volunteer would have to identify.

The IEPA had already determined tolerance values for stream macroinvertebrates in Illinois and a macroinvertebrate biotic index (MBI). Also, the procedures for the IEPA"s Facility Related Survey called for identifying macroinvertebrates to different taxonomic levels, depending on tolerance values-that is, that not all macroinvertebrates have to be identified to the level of family. For example, stoneflies are identified to the level of order (Plecoptera) since all but one stonefly species found in Illinois has a tolerance value of 2 or less. Mayfly families, on the other hand, vary widely with respect to tolerance values (from 0 to 6). Some mayfly families with similar tolerance values are clumped together-for example, "crawling mayflies" (tolerance value = 5.5), which consist of the families Tricorythidae and Caenidae. Also, because of the distribution of tolerance values of caddisfly families, caddisflies are identified simply as Hydropsychidae or Non-hydropsychidae.

My next question was, "What should I expect out of volunteers?" Based on my own personal experience with volunteers who conduct annual breeding bird counts and butterfly monitoring, I expected that a typical volunteer would be one who had very little ecological knowledge, yet was concerned about the environment. This was a low expectation, since I know that many volunteers involved with monitoring have some knowledge about the organism of interest. But I wanted to be prepared for the worst-case

scenario and be sure that the program trained the least educated individual for the job. Also, I knew that volunteers tend to be motivated people who lead busy lives, and I wanted to design a program that would keep their interest. Since several state agencies had shown an interest in the data, I solicited their help in the development of the macroinvertebrate collection methods for the Network. I received help from the INHS, IEPA and IDNR. Dr. Mitchell Harris, formerly of INHS and now of USGS, contributed greatly to the development of the habitat assessment protocols.

Sampling procedures

The macroinvertebrate sampling protocols were estimated to take no more than about 30 minutes to perform. Together with the habitat assessment protocols, the whole field portion of the program should take about 2 hours. Additional time, though, would be needed in a laboratory setting to identify the organisms. We estimated that sorting and identification of the sample (consisting of 100-200 organisms) would take a trained volunteer just over 1 hour to complete.

The sampling procedures involved the collection of macroinvertebrates from the two most diverse habitats available in a 200-ft section using a 12-inch dip net. Habitats, in order of decreasing diversity, are: riffles, leaf packs, snags, undercut banks, and sediment. After collection, a subsample of at least 100 organisms is taken if the sample is very large (i.e., over 200 organisms). The volunteers then sort, enumerate, and identify the sample. Macroinvertebrate data are used to calculate various indices such as taxa richness, density, percentage composition of key indicator taxa, and a Macroinvertebrate Biotic Index (MBI). All sampling protocols are found in the Illinois RiverWatch Network Stream Monitoring Manual (1994). We modified a field identification key developed by Joyce E. Lathrop (1989) so that only those indicator macroinvertebrate organisms were identified. All procedures, keys, and educational materials were placed in our stream monitoring manual. Volunteers were provided with a minimum training of 4 hours in the field for collection procedures, and at least 4 hours of macroinvertebrate identification. Regional coordinators offered additional assistance when requested by the volunteers.

Ensuring data quality

Quality control procedures, such as equipment and procedural specifications and data verification, maximize the reliability of the data for use by the scientific community. At least 30% of the volunteer-collected samples are verified by the quality assurance officer each year. Quality control procedures for data entry involve a three-step process whereby the volunteers verify their data sheet entries while at the stream site, the regional coordinators "recheck" the data sheets for any missed errors and carefully enter the data into the databases, and finally the quality control officer inspects the database entries before uploading onto the IDNR electronic bulletin board, the EcoForum. Consistency of equipment such as dip nets, measuring tapes, thermometers, subsampling pans, and velocity spheres (practice golf balls) is assured by providing stream monitoring kits for loan at each regional Illinois RiverWatch Network office. To ensure the quality of

training, quality control officers visit each regional office to observe actual training workshops.

The first Illinois RiverWatch Network Annual Assessment was held from May 1 to June 30, 1995. Approximately 200 volunteers monitored 108 sites on 93 streams throughout the state of Illinois. After the data were collected, several problems were identified. It was discovered that bloodworms and non-bloodworm midges were misidentified by the volunteers in 22% and 24% of the samples verified, respectively. This raised a major concern because bloodworms have a tolerance value of 11, and non-bloodworms have a tolerance value of 6. Yet, stream ratings based on the MBI did not change after sample misidentifications were corrected and MBIs re-calculated. Therefore, the misidentification of bloodworms and non-bloodworm midges was only a minor problem for the first year. Other misidentification problems were found with riffle beetles, some mayfly families, and damselfly families. These problems were considered minor since fewer than 10% of the samples contained misidentified organisms of these taxa. To alleviate future problems, the Network provided more training and developed a macroinvertebrate study guide to replace the dichotomous key. Many volunteers found the dichotomous key (Lathrop) to be confusing, as well as intimidating. A study guide was developed that consisted of large drawings and key identifying features of each organism. Also, to help with the identification of bloodworms (which can be easily identified by body shape and their "blood-red" color), we modified our collection methods. Bloodworms are now separated from the total sample and preserved in alcohol (either isopropyl or 75% methyl); the remaining organisms of the sample are preserved in a separate container. Finally, volunteers verify their bloodworm identification in a laboratory setting.

Another major data-quality problem involved data entry. Many mistakes were made during the entry of data into the databases by the regional coordinators. We determined that the mistakes were due to the coordinators" inexperience with computers. Training in computer use, data entry, and quality control procedures was given more emphasis for 1996. We also increased the emphasis on data quality and quality control procedures in the volunteer training sessions.

The Illinois RiverWatch is a successful scientifically based volunteer stream monitoring program. The Network has shown that volunteers can collect data of sufficient quality if provided with proper training in scientific procedures, including data quality and macroinvertebrate identification. The IEPA has used the first year"s data in their state water quality report. In the future, information on zebra mussel sitings will be included in an Illinois-Indiana Sea Grant database of exotic species.

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Restoring Estuarine Habitats

Moderator: **Christy Williams,** Izaak Walton League of America
Speakers: **Clifford Kenwood,** Lake Pontchartrain Basin Foundation; **Robert Musser, Jr.,** Tampa Bay Watch, Inc.; **Aimee Guglielmo,** Jefferson Parish Environmental Development Control Department

Clifford M. Kenwood
Project Coordinator, Lake Pontchartrain Basin Foundation, P.O. Box 6965, Metairie, LA 70009, 504/836-2215

Volunteer Sea Grass Restoration in Lake Pontchartrain, Louisiana

The Lake Pontchartrain Basin

The Lake Pontchartrain Basin is a 3,400-square-mile watershed located in southeast Louisiana. The basin is home to over 1.5 million people and includes most of the metropolitan New Orleans area. Land uses range from urban to suburban to agricultural. The basin also contains thousands of acres of productive wetlands, including three national wildlife refuges.

The centerpiece of the basin is Lake Pontchartrain, which, ironically, is not a lake. Rather it is a 620-square-mile estuary (average depth is only 12 feet) connected to the Gulf of Mexico through tidal passes and manmade channels. The Pontchartrain estuary is one of the most productive in the United States, supporting a multimillion-dollar fishery and providing recreational opportunities to the citizens of southeast Louisiana. The Lake Pontchartrain Basin Foundation, a nonprofit citizens" organization dedicated to restoring and preserving the Lake Pontchartrain Basin, was founded in 1989.

Lake Pontchartrain"s sea grass beds

Sea grass beds form one of the most productive habitats in the basin. Tape grass (*Vallisneria americana*), generally found in fresh water, is the dominant species in this estuarine system. The other primary species are *Ruppia maritima*, a true sea grass, and *Najas guadelupensis*. Values of the grassbeds include fisheries production, wildlife habitat, nutrient uptake and "recycling," shoreline protection, oxygen production, recreation (including commercial and recreational fishing), and ecotourism.

Unfortunately, the grass beds are also one of the lake"s most threatened habitats. They have declined by more than 80% since the 1950"s and are now relegated to a geographically small area off the lake"s north shore. Probable causes of the decline include shoreline "hardening" projects (seawalls, stone revetments, etc.), eutrophication, storms and hurricanes, urban runoff, dredging, loss of shoreline wetlands, and prop damage by recreational boaters.

Sea grass restoration in Lake Pontchartrain

In 1994, the Lake Pontchartrain Basin Foundation teamed up with researchers from the University of New Orleans Department of Biological Sciences (UNO) on a project to replant sea grasses in Lake Pontchartrain with volunteer assistance. Funding was provided by EPA Region 6"s Johnston Basin Cleanup Fund.

UNO performed extensive pre-monitoring to determine areas that could support sea grasses. The following water quality criteria were measured: light availability (by Secchi disk and photosynthetically active radiation, or PAR), pH, salinity/conductivity, alkalinity, carbon dioxide, and water depth. Three sites were selected based on water quality criteria and public access. At each site, four PVC and plastic mesh enclosures were constructed to reduce predation on the grasses, buffer wave energy, and prevent people from walking on the grasses while they were taking root. The enclosures measured 12 feet on each side, with a height of 4 feet and open tops and bottoms. The enclosures were placed in 2 feet of water.

Volunteer training

An extremely diverse group of volunteers, ranging from college students to professionals to retirees, were trained to harvest and transplant sea grasses and to perform weekly water quality monitoring at the transplant sites. Volunteers were trained at two levels. For each PVC transplant enclosure, one captain was trained at an evening session at UNO in proper planting techniques. Three additional volunteers assisted each captain on planting day. These volunteers were trained on-site prior to planting. Several harvesting captains were also trained at an evening session in identification procedures (fairly easy due to the low number of species in the lake) and proper harvesting techniques. On planting day, each harvesting captain worked with three additional volunteers.

All volunteers were briefed on safety concerns before planting. Safety concerns included glass on the lake bottom (volunteers were required to wear shoes); stingrays (volunteers

were told to shuffle their feet, not to step directly on the bottom); heat exhaustion (it was over 90 degrees with humidity levels above 80%); and basic water hazards.

Planting, harvesting, and monitoring

Plants were harvested from existing healthy beds in about one foot of water. Beds were "thinned" rather than "clear-cut" to minimize damage to them. Volunteers reached into the sand below the roots and carefully "fluffed" the sand below the plants to release them. Plants were driven approximately 15 miles to the transplant site.

Wearing a mask and snorkel, volunteers used their hands to dig a small hole in the sand, then anchored individual plants in place with a small metal pin. (The staples were removed a few months later, after the plants had taken root.) After planting, volunteers returned weekly to test water quality inside each cage at all three sites. Volunteers measured pH, water temperature, dissolved carbon dioxide, salinity/conductivity, alkalinity, turbidity (by Secchi disk and PAR), and water depth. They also performed a visual survey of the grasses and repaired the protective cages each week.

Results

Plants thrived at the two transplant sites on the lake"s less urbanized north shore, reproducing both sexually and vegetatively in their enclosures. Plants also expanded outside of some of the enclosures at these sites. Plants fared poorly at the more urbanized, higher-energy site on the south shore of the lake, where a powerful winter storm dumped approximately 6 inches of sand and gravel on top of the young plants, many of which never recovered.

A severe blue-green algae bloom (possibly the worst on record) completely covered the natural and transplanted grasses for nearly a week in July 1995, harming the existing beds and completely denuding the transplanted beds. However, by the fall of 1995, the beds were showing signs of recovery.

Difficulties encountered

Scheduling. Planting had to be rescheduled three times because of rough, turbid water and rain.

Human impacts. Children (and adults) were seen walking around inside the cages at two sites. Crabbers threw their traps inside the cages. A local aquarium club was caught harvesting plants from one of the cages.

Water quality/weather. A massive algae bloom in July 1995 had a severe impact on the transplanted and natural grasses. In addition, extreme low tides in winter caused desiccation (drying out) at all transplanting sites.

Maintenance. Cage maintenance was extremely time-consuming. Cages had to be repaired weekly and completely rebuilt at least 5 times after storms.

Cheap waders. Cheap "stocking foot" waders are not a bargain. We went through at least 12 pair before we broke down and bought real waders for our volunteers. Because of leaky waders, some water quality data was not collected during the winter months.

Possibility of total failure. There was a distinct possibility that the project could have failed completely, leaving volunteers (and coordinators) demoralized. Volunteers who planted at the south shore site were discouraged when their grasses died. These volunteers were taken to see the successful plots at the other sites to boost their spirits.

Conclusions

The project was considered a success. Researchers at UNO gained valuable information about sea grass transplanting and the public was made aware of the values of sea grasses. A great deal of media attention was generated, resulting in six television news stories and over a dozen newspaper articles, including two favorable editorials.

The project also fostered stewardship of the grassbeds. In 1996, a state shoreline protection project was proposed that could have harmed 25% of the lake"s remaining grassbeds. An outcry came up from project volunteers and members of the public; as a direct result of their actions, changes were made to the project that protected the beds.

Sea grass restoration by volunteers has been one of the most rewarding and proactive activities conducted by the Lake Pontchartrain Basin Foundation, and one that the Foundation plans to continue.

Robert E. Musser, Jr.
Tampa Bay Watch, Inc., 8401 9th Street North, Suite 230ĐB, St. Petersburg, FL 33702, 813/896-5320

Estuarine Habitat Protection and Restoration in Tampa Bay Through Volunteer Stewardship

Tampa Bay was once Florida"s most diverse and productive estuarine system, but years of rapid urban and industrial development have significantly altered the ecology of this, the largest estuary in the state of Florida. From the headwaters of the Hillsborough River through its mouth at historic Egmont Key, Tampa Bay has drastically changed. Over the past 100 years, the bay has lost 44 percent of its original 25,000 acres of mangrove and salt marsh habitat, and 81 percent of its original 76,500 acres of seagrass expanses. Causes of this dramatic decline include habitat losses from anthropogenic sources such as dredge-and-fill actions, poor water quality due to urban and industrial stormwater runoff, population increases, and various illegal and/or unintentional acts.

These losses have been acknowledged by the surrounding Tampa Bay communities. With a growing population of 2.2 million people in a tri-county area and over 100,000 registered boaters, the stresses placed on natural systems are intense-but through community involvement and education change is possible. Significant strides have been made to correct not only habitat losses but associated water quality problems throughout the bay.

Tampa BayWatch, Inc., a nonprofit environmental group, was formed to help combat these losses and problems by taking a stewardship approach to bay protection and restoration. Our mission is to coordinate volunteer participation in restoration and protection projects, monitor environmental conditions in Tampa Bay, identify and report problems, and educate the public on the importance of resource protection. We have accomplished these tasks by means of partnerships with state and county agencies, in which Tampa BayWatch supplies the volunteer task force to complete restoration projects-thereby saving taxpayers thousands of dollars. We also assist understaffed governmental agencies by identifying environmental problems and impacts and assisting in the resolution of these problems.

Because Tampa BayWatch provides trained staff and group leaders, who in turn train new volunteers in restoration techniques, the partnerships have allowed state agencies to concentrate on site preparation rather than volunteer training. On average, the volunteers save taxpayers $1 per plant installed, and salt marsh restoration projects usually range in size from 5,000 to 10,000 plants. Providing plants through our high school wetland nursery program will save even more money by eliminating the need to purchase many of the plants.

Tampa BayWatch has involved thousands of community volunteers of all ages in salt marsh restoration events, storm drain marking projects, coastal cleanups, and bird island monofilament cleanups, and has specifically involved high school students in our award-winning high school wetland nursery program. To date volunteers have helped to introduce and restore nearly 50 acres of salt marsh habitat back into Tampa Bay.

The high school wetland nursery involves constructing a wetland habitat on school property using a wooden frame, pond liner, and irrigation system. Salt marsh plants are either purchased or gathered from previously completed restoration projects and planted in trays in the nursery. The plants mature over a period of about six months and are then transported to a bay restoration site. Students assist in all aspects of building, planting, and harvesting the nursery, and get hands-on knowledge about the function of marsh systems. They also get the added bonus of helping to restore habitat back into Tampa Bay, hopefully instilling an environmental ethic that will endure into their adult lives.

The success of the stewardship approach can be illustrated through improving water quality, increased wetland and intertidal habitat, safer wildlife nesting and sanctuary areas, greater scientific knowledge, and the instillment in our students and citizens of an environmental ethic toward protection, restoration, and conservation.

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Aimee Guglielmo [1]

Jefferson Parish Environmental and Development Control Department, Coastal Zone Management Program, 1221 Elmwood Park Blvd. Suite 703, Harahan, LA 70123, 504/838-4230

Santa Saves the Marsh

Louisiana loses 30 to 50 square miles of coastal wetlands every year. The potential solutions to our land loss problem are most often as complex as the interaction of natural processes and human actions that have led to this catastrophe. Concerned citizens in Jefferson Parish are taking aggressive action to implement a simple, inexpensive plan to help slow marsh loss in the Barataria Basin. Since 1991, over

350,000 Christmas trees have been recycled into sediment-trapping brush fences. These "cribs" not only protect fragile shorelines, but also save valuable landfill space and serve as an extraordinary educational tool.

Jefferson Parish"s innovative Christmas Tree Marsh Restoration Project, the largest in the state, utilizes two types of crib configurations. Cribs built along shorelines act as breakwaters and groins to prevent lateral drift. The fences are approximately 4 feet wide and 150 feet long, with 2-by-4-inch treated boards driven into the mud 2 feet apart. The tops of the 10-foot boards extend approximately 2 feet above the high tide of 2.8 NGVD (national geodatic vertical datum). Loose trees are transported by barges (donated by

Texaco) to the project site. Volunteers transfer the trees from the barges to their own boats and then into the pre-built cribs. Once the crib is filled with trees, volunteers walk on the top to pack down the trees, then tie the trees in place with tar rope. This type of crib is currently protecting 11,000 linear feet of shoreline from wave action and subsequent erosion. Sediments are allowed to settle in the protected waters behind the fence, resulting in accretion.

The second type of crib is built across abandoned, dead-end canals once used for oil and gas exploration and extraction. These fences trap water hyacinths (*Eichhornia crassipes*) in the canals, thereby initiating the process of floatant marsh formation. By using to our advantage the characteristics that make this invasive exotic species such a nuisance, we have created floating mats that are now being invaded by a number of native species. Large bundles of trees are also placed directly into the canals to provide a lattice for accelerated colonization by native plants. These trees are secured into bundles of 40 to 50 by volunteers, mainly high school students. The bundles are then barged to the project site where they are airlifted by Louisiana Army Air National Guard helicopters into the canals. Approximately 20 acres of canals are currently undergoing this transformation as a result of a demonstration project funded by the Environmental Protection Agency through the Barataria-Terrebonne National Estuary Program.

This project is a model of corporate, inter-agency, and citizen cooperation. Although the project receives funding from the Louisiana Department of Natural Resources each year, it is largely dependent on donations of equipment and manpower. Christmas tree fences would not be feasible without corporate donors such as Texaco, Exxon, Browning-Ferris, Waste Management, and Cytec; without assistance from the Louisiana Army Air National Guard, the National Park Service, the U.S. Army Corps of Engineers, the U.S. Coast Guard, the Louisiana Department of Wildlife and Fisheries, and the Louisiana Department of Transportation and Development; or without the time donated by an average of 500 to 600 volunteers each year from every sector of the community, including fishing and hunting clubs, scout troops, high school students, environmental organizations, civic groups, and concerned individuals. The media attention generated by the project has been a key to our success with volunteer recruitment and corporate sponsorship. Aside from the obvious benefits of protecting, enhancing, and creating wetlands and saving landfill space, this annual event continues to turn the public"s attention to Louisiana"s coastal loss problem.

[1]*Aimee Guglielmo is no longer with the Department. For information on the Christmas tree project, please contact Marnie Winter or Jason Smith at the phone number listed above.*

Setting Program Goals That Incorporate Stewardship

Moderator: **Sharon Clifford,** Missouri Department of Natural Resources
Presenters: **Molly MacGregor,** Mississippi Headwaters Board; **Jeanne Heuser,** Missouri Stream Team; **Rosie Rowe*** and **Vera Lubczenko,*** Waterwatch Australia; **Derek Foster,*** Dept. of Primary Industries (Australia)

Molly MacGregor
Mississippi Headwaters Board, P.O. Box 3000, Walker, MN 56484, 218/547-7263

How the Public Perceives Stewardship of the Mississippi River

I will begin by describing the roles that have brought me here today.

First, I am a member of the steering committee of the National Volunteer Monitoring Conference and have helped to organize the stewardship track of this conference.

Second, I am a coordinator of a water quality monitoring and protection network, established at 30 locations across the drainage basin of the Mississippi River in Minnesota.

Third, I am the manager of a river management program regulating the Mississippi"s first 400 miles.

Fourth, I am a board member of two national river groups-the River Management Society (formed through the merger of the River Federation and the American River Management Society) and River Watch Network.

These roles illustrate the point that while my professional life is based on realizing successful stewardship of the Mississippi River at the local level, I am helped to achieve this by the support of national organizations and the opportunity to communicate with colleagues from across the country.

The objective of this conference is to encourage volunteer monitoring groups to recognize and expand their role in watershed stewardship. The objective of this session is to help volunteer monitoring groups incorporate stewardship into their individual programs. In organizing this session, we realized that some groups started with volunteer monitoring and arrived at stewardship as an outcome of that initiative; others pursued stewardship as an organizing principle. The goal of my remarks is to underscore the importance of the connection between stewardship and monitoring: successful monitoring leads to stewardship; successful stewardship requires monitoring.

The single most important action a water resource protection agency can take to create stewardship is to establish a volunteer-based, scientifically based program, which is fundamentally connected to decision making. I propose to make this case using two sources: (1) Evidence from this conference and previous volunteer monitoring conferences, and (2) Research about public perceptions of stewardship of the Mississippi River conducted by the McKnight Foundation of Minneapolis.

At this conference, the various discussions of stewardship include these elements: responsibility, action, and the future. The critical elements of volunteer monitoring identified by speakers are: participation, credibility, communication, and action.

At this conference we discussed the idea that stewardship is citizenship. Steve Born told us that citizen monitoring can create local ownership of a water resource. Joe Farrell told us that stewardship requires an attitude of care toward the resource. Paul Godfrey told us that successful citizen monitoring reminds participants that each is part of a participatory democracy. Certainly, successful-by which I mean credible-volunteer monitoring gives citizens additional tools to participate in decision making about water resources.

These ideas are critical to keep in mind when your organization is designing, discussing, and recognizing the efforts of your volunteer monitors. You are not just celebrating the river, or understanding complex ecological connections-you are providing people with a unique means to govern their precious resources.

The McKnight Foundation is a family foundation founded in 1953 by the founders of 3M, or Minnesota Mining and Manufacturing-the Scotch tape and video- and audiotape people. The foundation is run by the family and gives about $8 million annually. Arts and education were the prime giving targets. But the foundation has had a unique perspective. As a statewide foundation, it was concerned that its resources not be gobbled up by the Twin Cities metro area. In the mid-1980s, it spawned five regional foundations around Minnesota-which began with McKnight money but are no longer dependent on it. In 1991, it started a Mississippi River program, which has had a national focus. The foundation devoted $9 million over five years to this initiative. Characteristically, McKnight hasn"t just made grants. They have engaged in research designed to improve the effectiveness of river protection groups operating up and down the Mississippi.

In fall 1995, McKnight staff decided that market research about public attitudes toward the Mississippi River and the concept of stewardship would assist river groups. This work was inspired by the work of American Rivers, which found that more than 90 percent of the American public reacted strongly and positively to the statement, "We ought to protect our rivers as a source of drinking water for our children" (a finding that apparently was staggering to the market research firm, which typically studied public responses to soft drinks and the like). The American Rivers survey found that people didn"t know where their drinking water came from-and that a small percentage believed it came from the oceans!

McKnight convened three sets of focus groups-in the Twin Cities metropolitan area, in rural Minnesota, and in the Quad Cities area. These groups were designed to be middle income, middle class and generally "middle of the road." The market research firm worked with McKnight and its grantees in designing the survey instrument. Research groups were convened and interviewed. Some results:

- 90 percent of the focus groups agreed with the statement, "We must be responsible stewards of the Mississippi River."
- Focus group participants said they generally felt powerless.
- People care about the Mississippi, but feel detached from it and lack any real connection to the river, other than driving over it.

- People don"t have time to learn about the environment, and are not likely to make time.
- Three-quarters of the respondents use local TV news or small-town newspapers as their first and second sources of information.
- Focus groups respondents were asked to react to commonly used words and phrases. Interestingly, the reaction to the word "watershed" was negative.
- People respond to messages that the water quality of the river is threatened or that the heritage of the river is threatened.
- People favor local approaches to river stewardship-the words "community partnership" were very positive.
- People favor action-oriented approaches to river stewardship.
- People think that polluters ought to be held accountable.
- People favor research and monitoring as stewardship tools.

As a result of the research, McKnight"s research firm created the following checklist for river protection groups to use to evaluate ideas, projects, and organizations:

- Does the organization have a people-centered mind-set?
- Does the project focus on appropriate target audiences or does it preach to the converted?
- Is the project action-oriented rather than process-oriented? Does it tell individuals what they can do, and is it realistic about what people will take on?
- Does the project propose strategies that will move people from apathy to concern, connection, and ultimately, action?
- Do the group"s communications identify solutions as well as problems?
- Does the organization get its messages out in places where target audiences can be reached?

The McKnight researchers also investigated the question of how people describe their relationship with the river. Respondents recognized the importance of the river to themselves in the following ways: (1) the river"s connection to public health (the Mississippi provides drinking water for one-quarter of the state"s population), (2) the river"s ability to enhance their enjoyment of life, and (3) the river as a legacy to future generations. Although respondents recognized the importance of the river to themselves, they needed assistance in finding a way to express that relationship within their own lives, in a way that they can manage.

Despite recognizing that the river was important to them, respondents felt that they did not have a direct connection to the river. What experiences can we provide to create this connection? Obviously, volunteer monitoring-which literally puts you in the river-makes this connection. The challenge that we as volunteer monitors face is to help individuals make that connection between their beliefs and the actions that they can engage in as individuals and, most importantly, as citizens of the watershed.

The critical elements of stewardship discovered in this market research were its local, and even personal, foundation; its orientation toward people and their future; and its

grounding in action. All of these are very close to the themes of responsibility, action, and the future which have seemed to define stewardship at this conference.

At the start of this conference, Gaylord Nelson challenged us to create a conservation ethic to address problems of population growth and to meet the challenge of establishing a sustainable society.

Two years ago in Portland, David Duncan confessed that at some point in his adult life, he had given up on the idea of saving the world. It was mathematically impossible, he decided. Instead, he had become vitally interested in taking care of his small share of the planet, and he described improving a trout stream on his Montana property. A few weeks ago, I had the good fortune to hear Duncan"s next chapter of that story-the joy of catching the first brown trout from that stream, and then returning it to the stream.

At this conference, we have heard speakers describe stewardship as care, as citizenship, as democracy in action. Market research on the Mississippi confirms these observations. Clearly, we as the managers of volunteer monitoring have our hands on a tool that can help people make the connection between belief and action. We have the power to spark a conservation ethic.

Jeanne Heuser
Missouri River Communities Network, Route 1, Box 4030, Jamestown, MO 65046, 816/849-2589

Monitoring for Stewardship on the Missouri River

Defining stewardship

Stewardship is a word new to many of us. It is often hard to define because it has a variety of interpretations, as will be demonstrated in this presentation. My personal favorite is "serving as a caretaker for the resource you love." In my case, I love the Missouri River and live less than two miles away from it. The creek crossing Echo Valley, the land I live on in rural mid-Missouri, drains a small watershed that feeds into the Missouri.

But there is more to stewardship. Its meanings can be expanded to include:

- recovering the natural dynamic of the resource"s ecosystem
- managing the resource for the benefit of all the different human and animal uses
- solving problems by undertaking "hands-on" projects identified as necessary to improve the resource.

The Missouri River Communities Network

In June 1993, after moving to mid-Missouri, I attended a workshop called "Missouri River Communities Conference: Reconnecting Your Community to the River," hoping to

get more involved in issues affecting the river. Little did we know that June just how "reconnected" communities would soon get to the river when the Great Flood of 1993 hit the following month.

By the spring of 1994, the Missouri River Communities Network was created as a nonprofit organization with the mission of serving as a partnership to rediscover the Missouri River as a scenic, cultural, environmental, and economic resource. I volunteered to serve as the director of the fledgling organization-and that began my crash course in learning about this incredible river that is the longest and most highly engineered river in the country, has a watershed covering one-sixth of the United States (including 10 states, 25 Indian tribes, and parts of Canada), and has elevations that range from 14,440 to 400 feet with significant differences in rainfall from the Rocky Mountains to the confluence with the Mississippi River in St. Louis.

Missouri River Dreamin" meetings held to envision the river"s future

During the winter after its inception, the Network held a series of town hall meetings entitled "Missouri River Dreamin"." Our goal was to identify the visions people had for the future of the river, to help us determine our plan of action for the Network. Over a two-week period we held eight meetings, starting in St. Charles on the east and ending in St. Joe on the west with 350 people attending. At each meeting the participants were split into small groups to record their ideas. The small groups then selected their priority issues by using three dot labels and totaling which issues received the most dots.

In general, comments were split between immediate problems and future visions. Responses fell into six categories:

1. Political questions " private property rights, flood costs and subsidies, and government control
2. Coordinated management " expanding the dialogue and management of the Missouri River system
3. Watershed management " flood control, floodplain uses, water quality, and ecological recovery
4. Master Water Control Manual " issues around the changes suggested by the Army Corps of Engineers to manage the water flow in the river system
5. Economic development " balancing current river uses (i.e., agriculture and navigation) with new uses (heritage tourism and recreation)
6. Education " understanding the natural history and importance of the river; taking pride in its cultural resources

From the Dreamin" meetings the Network developed goals to:

- Encourage stewardship of the river"s cultural, natural, and social resources
- Promote protection and recovery of the environment and economy
- Increase understanding of the river to help communities make sound resource management decisions

- Assist government agencies to develop and implement programs that improve the health and economic viability of the Missouri River Basin in coordination with its residents

Network adopts the river as a Missouri

Stream Team

Note that word *stewardship* in our very first goal! As our first activity under the goal of stewardship, we adopted the entire 553-mile stretch of the Missouri River through the Missouri Stream Team program (a program coordinated by the two state agencies, the Missouri Department of Conservation and the Missouri Department of Natural Resources, and a nonprofit citizens" group, the Conservation Federation of Missouri).

Missouri River Stream Teams have three goals:

- Education to understand how the river system functions within the watershed
- Stewardship to conduct hands-on projects such as stream-bank stabilization, litter control, restoration, etc.
- Advocacy to support efforts in the political world to improve natural resources.

There is that stewardship goal again! The big question facing the Network was how to begin our stewardship activities with such a large resource: the Missouri River watershed covers two-thirds of the state and supplies drinking water for close to 2 million people! The first thing we did was divide the river into seven more manageable regions.

Our stewardship activities focused on the water quality of the river. We knew water quality problems were not restricted to the river itself, and that towns and farms on tributaries also contribute to pollution in the river through point and nonpoint sources. We decided to work within the existing structure of Stream Teams by forming associations of the groups in each of our regions to conduct projects improving water quality. We started in Region 3, where association-building was already being initiated, and joined the effort to create Show-Me Clean Streams.

Show-Me Clean Streams takes on storm water management

By 1995, Show-Me Clean Streams was organized, consolidating all the Stream Teams in a four-county area with the mission of serving as a partnership to conserve and enhance the quality of mid-Missouri rivers and streams through education, advocacy, and stewardship. Goals are to:

- Influence public policy by promoting sustainable development and water pollution prevention
- Increase public awareness and appreciation of watershed management issues
- Enhance watershed stewardship by expanding Stream Team involvement

There's that stewardship goal again! Even before we had a chance to finalize our plans, residents in Columbia, the largest city within the four counties, sought out Show-Me Clean Streams to help with a problem they faced concerning the meandering streams in their backyards. The city government had begun implementing newly designed plans for storm water control and their streams were about to become concrete channels bordered on both sides by chain link fences.

In the stewardship world, most of us already know that this type of storm water management strategy only exacerbates flooding farther downstream-eroding stream banks, clogging the water with sediment, and concentrating pollutants. Unfortunately, the city is concerned only with flood control and is not looking at storm water quality issues in its planning-a big oversight for a community of almost 75,000 people.

Show-Me Clean Streams has taken on storm water management in Columbia as a priority activity and has helped form a group to address these issues directly with the city government. The Storm Water Partnership is supported by a variety of technical experts and local organizations and is currently providing alternative storm water planning ideas to the government. The Network is working on an EPA grant with the Missouri Department of Natural Resources to help facilitate this process in Columbia and to determine exactly how an unregulated community needs to manage storm water for water quality improvement.

At this time communities of under 100,000 population do not have to comply with NPDES requirements for storm water reporting, yet all towns, regardless of size, are contributing to nonpoint source water contamination from storm water runoff. The EPA grant will allow the Network to continue working with Show-Me Clean Streams and the Storm Water Partnership to help determine the best methods for storm water management through volunteer participation with GIS inventory mapping and water quality monitoring. After completion of this project, the Network will replicate the process in its other six regions, with the long-term stewardship goal of improving the water quality in the Missouri River.

The many faces of stewardship

Through all the examples in this presentation, stewardship has been one of the primary goals guiding the activities of each newly formed organization:

- Missouri Stream Teams" stewardship goal includes identifying problems and addressing them through hands-on projects that help improve the stream.
- Missouri River Communities Network encourages stewardship of the Missouri River as a goal and adopted the Missouri River as a Stream Team to begin forming associations of Stream Teams for water quality projects.
- Show-Me Clean Streams" stewardship goal means expanding the number of people involved in Stream Teams and influencing public policy for sustainable development and pollution prevention.

Putting all the stewardship goals together enhances the ability of organizations to form partnerships to develop projects, like the Storm Water Partnership working with the city government on storm water in Columbia. Such partnerships make it easier to raise funds and motivate volunteer participation to help solve local problems. By choosing stewardship as a goal of our organizations, we are accepting our responsibility as caretakers of our rivers and streams. Through this understanding of our connection to the waters we live near, we can recover the health and vitality of the Earth.

How to Assess Nonpoint Source Pollution

Moderator: **Joan Drinkwin,** Puget Sound Water Quality Authority
Panelists: **Joan Drinkwin,*** Puget Sound Water Quality Authority; **Anne Rogers,** Texas Natural Resource Conservation Commission; **Jeffrey Schloss,** University of New Hampshire Cooperative Extension

Anne Rogers *Texas Natural Resource Conservation Commission, P.O. Box 13087, MC-150, Austin, TX 78711-3087, 512/239-4597*

Urban Watch: A New Approach to Monitoring Urban Nonpoint Source Pollution

The Urban Watch program is a new approach to volunteer monitoring of nonpoint source pollution. It addresses several pressing needs relating to volunteer monitoring and to the management of nonpoint source pollution in urban areas. The monitoring provides cities with information they need to meet the requirements of a federally mandated permit, the National Pollutant Discharge Elimination System (NPDES) permit. The program educates citizens about nonpoint source pollution and involves them in its management. The random sampling schedule provides more flexibility for volunteers. And the data interests volunteers because it is generally more variable than that usually collected when monitoring for ambient water quality variables.

Nonpoint source pollution is finally being recognized as certainly a-if not the-major cause of surface water degradation in urban areas. With the growing public awareness of the problem comes a groundswell of good intentions aimed at solving it. Urban Watch is a means to integrate these good intentions with the mandates put on cities by the federal and state governments. Urban Watch offers cities an opportunity to obtain needed data while educating the public about nonpoint source pollution. At the same time, Urban Watch provides citizens with a means to effectively help solve the problem of nonpoint source pollution in their community.

The Urban Watch monitoring design was developed in cooperation with the City of Ft. Worth"s Department of Environmental Management, and follows the city"s initial field screening protocol to detect illicit discharges and illegal connections to the city"s storm drain system. It is a dry-weather field screening protocol. This means monitors are looking for flow in the storm drain system during dry weather (when flow should be absent or should consist only of natural base flow). Therefore, monitors never sample

within 48 hours of significant rainfall. Volunteers monitor a minimum of twice per month, with the two sampling events performed within 24 hours of each other. This strategy helps in detecting a potential illicit discharge into the storm drain system by having the volunteer sample at random times rather than on a fixed schedule.

Monitors do field tests for chlorine, copper, detergents, phenols, ammonia-nitrogen, pH, temperature, turbidity, and color. Each of these variables is an indicator of specific pollutants related to illicit discharges and illegal connections. For example, copper is a heavy metal used in many industrial processes. Its presence is a problem in itself, but it also indicates the possible presence of other heavy metals and industrial pollutants. Chlorine, for another example, is used in treating water for drinking and its presence can indicate a leak into the storm drain system from the sanitary sewer system. Its presence can also indicate problems with car washing, swimming pool draining, and possible industrial discharge. Monitors also take note of a wide variety of physical characteristics at their site, including the presence or absence of sewage, scum, and trash.

The Urban Watch kit is manufactured by LaMotte Chemical Company and is the same field test kit developed by the City of Ft. Worth personnel to perform their NPDES storm drain screening requirements. The kit costs around $300.

The most crucial aspect of an urban storm drain monitoring project such as this is that there be buy-in from the city at the beginning of a project"s design. There is little state or federal agencies can do with storm drain data as these systems really belong to the city and it is the city which has to address any problems related to the storm drain system. Cities that implement volunteer monitoring of their storm drain systems have taken a real step forward in helping to identify and mitigate urban nonpoint source pollution.

This presentation was based in part on Joan Drinkwin"s article, "Urban Watch: A New Approach to Monitoring Urban Nonpoint Source Pollution," in The Volunteer Monitor newsletter, Vol. 7, No. 2 (Fall 1995), pp. 4"5.

Jeffrey Schloss
New Hampshire Lakes Lay Monitoring Program, University of New Hampshire Cooperative Extension, 55 College Road, 109 Pettee Hall, Durham, NH 03824, 603/862-3848

"Following the Flow": A Watershed NPS Evaluation System for Citizen Monitors

New Hampshire was one of the first states to show that properly trained and equipped citizen monitors could collect valuable water quality data useful for assessing the health of lakes. Today, a variety of volunteer monitoring groups are sampling estuaries, rivers, streams, lakes, and wetlands and providing much-needed information to agencies and decision makers. In the process, the participants learn a great deal about the dynamic nature of these aquatic systems, their value, and how our actions affect these resources.

The participants also spread the word to their children, neighbors, town officials, and association members.

When monitoring indicates a water quality problem, the cause of the disturbance is often hard to detect if it involves nonpoint source pollution. It is generally not cost-effective for an agency, professional, or volunteer to sample water chemistry or investigate biological integrity throughout the watershed. A visual survey method would be optimum. Typically, even a subwatershed can have a variety of land use impacts: Is sediment from a construction site causing the problem downstream? Or are the nutrients lost from the corn field just upstream the cause? How about the newly constructed logging road? Or is that just-fertilized lawn on the lakeshore the culprit?

Because there was no systematic approach or method for the layperson to evaluate the seriousness of an erosion, sedimentation, or runoff problem, an interdisciplinary, inter-agency effort was undertaken in New Hampshire to create this needed assessment tool.

An approach to conducting a visual survey for NPS pollution

"Following the Flow" is a watershed site evaluation method developed through the efforts of the University of New Hampshire Cooperative Extension (UNH CE), the New Hampshire Lakes Lay Monitoring Program, and the USDA Natural Resources Conservation Service. As this was to be a visual survey method, sediment was the primary nonpoint source (NPS) pollutant chosen. Sediment is discernible as a plume in the water after a storm event, and during dry periods it can be observed to collect on-site and in deposits and deltas. Sediment can also be a good surrogate indicator for additional NPS pollutants such as nutrients (especially phosphorus, which is often attached to particulate materials), organic matter, pesticides, and bacteria.

The approach of Following the Flow is graphically depicted on the next page. Basically, the method uses the following questions to evaluate NPS problems:

- What is the potential for erosion or pollution production to occur given the characteristics of the site (soils, slope, vegetation, etc.), site history, and contributing areas above the site?
- Is there evidence of sediment or related NPS pollution being generated on the site?
- Are there measures in place to limit or prevent NPS pollutants from being generated (best management practices, or BMPs)? If so, do they seem to be working?
- If NPS pollution is generated on the site, could it easily move off the site or are there vegetative buffers in place?
- Is there evidence that material has moved off the site?
- Is there a transport route that would allow this material to get to the water?
- Is there any evidence of impact on the receiving water?

This method provides a systematic approach for the student or layperson to evaluate the seriousness of erosion, sedimentation, or runoff problems. For each type of impact site, specific questions relate visual indicators, impacts, best management practices, and land use activity. While the questions differ, the approach described above remains consistent. Site worksheets have been developed for a range of agriculture activities, logging operations, construction sites, shoreline areas, residential developments, roads, parking lots, and boat ramps. A neighborhood evaluation has been developed to assess homeowner practices and the density and design of developments. This section has also been modified for self-assessment by homeowners and students. You can evaluate a site and then move down to the receiving water (stream, river, lake, estuary, or wetland), or you can start at the water and move up the watershed. The evaluation can be done at existing sites to determine actual or potential pollution problems or it can be used to estimate potential impacts of proposed land use changes for specific watershed areas.

The "Following the Flow" Watershed NPS Site Evaluation Method is shown here in a schematic diagram. The method consists of a series of observations for the receiving water (lake, river, stream, or wetland), the impact site, and the transport route that connects the two.

The receiving waters evaluation can be strictly qualitative using the assessment sheets provided, but there is also the option of utilizing water quality information from any of the New Hampshire agencies or volunteer monitoring programs. The method even allows the option of using a simple macroinvertebrate index (equipment for this testing is already available for loan at all ten UNH CE county offices and our county youth education center). Thus, this project can complement existing volunteer monitoring programs, utilize results from our ongoing school programs, and encourage further public participation.

Method refinement

A pilot program was undertaken in 1995 as part of the interagency Lake Winnipesaukee Watershed Basin Outreach and Education Program, using volunteers from two lake associations. A second program was initiated in 1996 as part of a watershed study of Swains Lake in Barrington, NH, using a team of senior college students from the UNH Natural Resources Department. This multidisciplinary team was composed of students that specialized in water resources, soils, forestry, wildlife, and environmental conservation. That same year, a modified version of the method was used by Salem (NH) High School students to conduct neighborhood NPS surveys as part of the educational efforts of a source water protection project. After these initial trials were evaluated, appropriate changes were made to the method. Slides from the pilot programs and field testing were copied and compiled for use as a training workshop tool. A second slide program was developed to serve as a "teaser" to generate interest in use of the method. Finally, a pilot training workshop was held.

Training for the method

Training for Following the Flow involves both lectures and field work, and can take a day or more depending on the number and type of sites the participants will evaluate. Skill building required includes interpretation of topographic maps, soil maps, and aerial photographs (which monitors will use before, during, and after their site visits). Watershed delineation and shoreland survey techniques are also covered. The major educational emphasis of the lecture and field training is on watershed processes, land use activities that generate NPS pollution, visual indicators of pollution, and best management practices (their design and how to tell if they are working). While it may require a professional to design the proper BMP or conservation practice, it does not usually take a "rocket scientist" to be able to tell if these controls are working successfully. Training also includes a "walk-through" of the method at selected impact sites.

Once the site evaluation sheets are filled out, the scores are transferred to the interpretive graphic (see above). Arrows are colored in completely for poor conditions and left blank for good conditions, with partially colored arrows for scores in between. This offers a visual aid to the interpretation of the results. Interpretation of the various outcomes is discussed in the training, and these scenarios are also catalogued in the training manual. During training, participants are linked with the professionals and agencies that can assist with confirming or mitigating problems the volunteers discover, and with preventing future problems.

Methods manual

The training manual utilizes a series of data sheets with objective questions to assess various impact sites and receiving waters. (This format is loosely based on *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire,* by Alan Ammann and Amanda Stone.) Instructions cover how to develop a monitoring strategy; when and where to monitor; how to fill out the appropriate site evaluation, transport route, receiving water, and summary sheets; and how to interpret the results. The appendices, which are in the form of a watershed analysis tool kit, include sources of information for the surveys, interpretation of topographic maps and watershed delineation, measuring percent slope, evaluating best management practices, tables that list the erosion potential of New Hampshire soils, and a list of cooperating agencies that can assist in preventing or mitigating problems.

Outcomes

The uniqueness of this approach is that sites are evaluated not only for evidence of pollution but also for potential problems based on the nature of the site and whether management practices are in use. This allows potential problems to be found and dealt with before they become actual problems. This method is also proactive since it assists the landowner by recommending the appropriate resource agency with the expertise to correct or prevent the problem. Thus the approach offers a "helping hand," rather than the "slapping hand" of enforcement activities. This, in turn, creates partnerships instead of barriers between the public, landowners, agencies, and decision makers.

Following the Flow provides a model program with high transfer capability. With little modification this project could be applied throughout the country. Only the contact agency list, the soils erodibility tables, and perhaps some of the covered BMPs would need to be modified. The basics of the Following the Flow methods manual have also been incorporated into existing New Hampshire youth curricula.

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CONCURRENT SESSION 7

Program Roundtable A

Facilitator: **Alice Mayio,** U.S. Environmental Protection Agency

Stacy L. Daniels & Thomas Osborn
Crystal Lake Watershed Fund, Inc., P.O. Box 104, Beulah, MI 49617, 616/882-5149

Managing and Presenting Monitoring Data for a Large Inland Lake

Stewardship of the Crystal Lake Watershed involves a balanced approach to meet scientific and community needs while interfacing with diverse groups that often have differing opinions as to what parameters should be monitored, who should conduct the studies, and how data should best be collected, interpreted, and utilized. Volunteer efforts of the Crystal Lake Watershed Fund, Inc. (CLWF) have been directed by local environmental professionals, while encouraging active involvement by local citizen volunteers, schools, regional colleges and universities, and governmental agencies.

Background

Crystal Lake, an oligotrophic lake in Benzie County, is the tenth largest inland lake in Michigan and contains 242 trillion gallons of water. The watershed covers 21.8 square miles, with approximately 75% (16.4 sq. mi.) being the lake surface. Maximum depth approaches 175 feet (mean 70.7 feet). The watershed encompasses portions of four townships, served by wells and septic tanks, and two small communities, with municipal

water supplies and sewers. Lakeshore residences are predominantly single-family with seasonal usage. A landmark county ordinance ensures that septic systems are maintained at current standards. The lake is almost entirely surrounded by high forested bluffs surrounding a narrow beach zone created by a dramatic drawdown in the logging era. Crystal Lake had no natural outlet to Lake Michigan until 1873 when its level was permanently lowered.

The deep waters of the open lake are oligotrophic and water quality is exceptionally high. Nearshore waters show slightly elevated levels for some parameters, but water quality is still very good. Nutrient loading and sediment transport are of some concern, but development and land use (if not properly managed) have potential for much greater adverse effects upon water quality. Nutrient input is limited by the absence of major point sources and the small land/water ratio of the watershed. Sources include one major and several minor tributaries, individual septic systems, and atmospheric deposition. Sediments are surface runoff from the tributaries, storm drains, and localized construction activities. Manageable sources are being addressed to control inputs and protect the environmental quality of the watershed.

Environmental science and water quality monitoring program

CLWF sponsors a comprehensive Environmental Science and Water Quality Monitoring Program. The CLWF is a 501(c)(3) organization, formed in 1994 upon merging the Clean Water Committee of Crystal Lake (with a focus on water quality monitoring) and the Friends of Crystal Lake (with a focus on land use and zoning). Like its predecessors, the CLWF actively supports citizen initiatives for water quality monitoring, septic system control, sustainable development, and land conservancy through education. The CLWF Program is directed entirely by local environmental professionals, which allows flexibility in experimental design, sampling, analysis, evaluation, and training. This is in keeping with well-established state and national programs that encourage proactive involvement by local citizens, local schools, and regional universities with local, state, and federal agencies acting in advisory, consulting, and participatory roles. The CLWF Science Review Panel and an external reviewer provide oversight.

Environmental studies of the Crystal Lake Watershed over the past 80 years have addressed short- and long-term impacts and future trends, and include water quality monitoring; geological, hydrological, and ecological surveys; fishery surveys; algae identifications; septic system assessments; and aerial, topographical, and land surveys. Options for wastewater collection and treatment for two contiguous watersheds were considered in a detailed facilities plan. Crystal Lake was the first EPA case study to receive a finalized Environmental Impact Statement (EIS) of alternative waste treatment systems for rural lake projects. It is the location of an ongoing grant as part of the National Onsite Demonstration Project. The CLWF program builds on these studies. It involves both routine year-round monitoring of conventional environmental parameters and original scientific investigations of the Crystal Lake Watershed.

The CLWF also participates with the Benzie County Section of the Grand Traverse Regional Land Conservancy, the Benzie/Leelanau County Public Health Department, and the Interlochen Arts Academy, as well as with other lakes, in joint programs of the Michigan Lake & Stream Associations, the North American Lake Management Society, the Michigan Sea Grant Program, the Michigan Department of Natural Resources, and the U.S. Environmental Protection Agency. Active dialogue among scientific and community groups is important in building a broad committed base of support and joint participation.

The CLWF Program is integrated into nine components:

1. Water Quality Survey: Water quality monitoring of the Crystal Lake Watershed.
2. . Secchi Disk Program: An annual program specific to water clarity.
3. Water Quality Testing Program: Biannual determination of nine water quality parameters.
4. Advanced Self-Help Program: An annual program specific to total phosphorus.
5. Citizens' Lake Monitoring Program: A pilot workbook program with 17 Michigan lakes.
6. Innovative Treatment: Support of demonstrations of processes for individual onsite wastewater treatment systems.
7. Biological Survey: Monitoring of plankton, macrophytes, fish, etc., including zebra mussels and Eurasian watermilfoil.
8. Adjacent Watersheds: Studies in parallel with other watersheds in the region.
9. Educational Programs: Hands-on experiences in water quality monitoring; "Eco-Explorations" with students.

The CLWF Program encompasses five "sampling regimes" within the Crystal Lake Watershed:

1. Deep-Lake: Open waters of the lake, including bottom sediments.
2. Near-Shore: Littoral zone about the lake perimeter.
3. Cold Creek: Locations throughout the major tributary.
4. Tributaries: Additional locations including minor tributaries and the outlet.
5. Miscellaneous Events: Selected natural and anthropogenic (manmade) events.

CLWF volunteers have conducted numerous surveys which have provided opportunities for students and interns to gain field experience in water quality monitoring. Physical, chemical, and biological parameters selected for monitoring in the CLWF Program are based on recognized importance and/or historic significance in past studies:

Physical: Water depth, Secchi disk depth, turbidity, air and water temperatures.

Chemical:DO, conductivity, pH, redox potential; ortho, soluble, and total phosphorus; dissolved and suspended solids; hardness, alkalinity, chloride, sulfate; ammonia, nitrate, nitrite, and organic nitrogen; and individual elements: aluminum, arsenic, calcium, copper, chromium, iron, magnesium, manganese, potassium, lead, silica, sodium, zinc.

Biological: Algae, plankton, macrophytes, and other aquatic species, including exotics, and chlorophyll a.

Other: Rain, snowmelt, shoreline deposits, stream flows, soils, and sediments.

Monitoring equipment includes a differential global positioning system (DGPS) for sample locating, conventional water samplers, a sediment corer, plankton collection devices, and a multiparameter sampling probe (Hydrolab H20[a]) with automatic data logger for uploading to a personal computer and an extensive database. Analyses have been performed during sampling (vertical profiles), at local laboratory facilities on the lake, at local schools, and at the Great Lakes Water Quality Laboratory, a local facility, following QA/QC procedures and standard methods.

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Jay Sandal
Superior Lakewatch, Lake Superior Center, 353 Harbor Drive, Duluth, MN 55806, 218/720-3033

Superior Lakewatch: The First Five Years

Superior Lakewatch is an international citizen-based lake monitoring program. The principal objective of Superior Lakewatch is to involve citizens of the Lake Superior basin in developing a database that can be used to document current water quality conditions and evaluate trends in water quality over time. The program, which is modeled after successful efforts on inland lakes, is the first of its kind on the Laurentian Great Lakes.

Since 1991, volunteers in Minnesota, Wisconsin, Michigan, and Ontario have been using Secchi disks to document water transparency of Lake Superior. A report that provides a summary of the water transparency conditions of Lake Superior, as well as empirical relationships between chlorophyll levels and water transparency for different areas of Lake Superior, has recently been published by Lake Superior Center in Duluth, Minnesota.

The principal conclusions of this effort are:

1. Lake Superior's near-shore waters vary considerably in clarity, ranging from Secchi readings of 62 to 0.5 feet.
2. In western Lake Superior chlorophyll levels and water clarity are not correlated and chlorophyll levels must be measured directly.
3. Superior Lakewatch should be continued. Evidence from long-term data collections by volunteer monitors on inland lakes show that Secchi disk monitoring can produce statistically valid information which can be used to document changes in water quality.

Cindy Kreifels
The Groundwater Foundation, P.O. Box 22558, Lincoln, NE 68542, 402/434-2740, email: kreifels@groundwater.org

Groundwater Guardian: A Program for Community Watershed Protection

Clean, drinkable water is one thing many citizens of the United States take for granted. An often-forgotten but critical resource, groundwater is the source of drinking water for over 50 percent of Americans.

Wellhead protection and groundwater monitoring are essential pollution prevention measures taken by many communities to ensure the quality of the community drinking water. The Groundwater Foundation strongly believes groundwater protection must be implemented at the community level with local citizens solving local problems. With this guiding philosophy, the Groundwater Foundation developed a program to promote community-based groundwater protection solutions on a nationwide basis. Through Groundwater Guardian, the Foundation provides support and recognition for communities taking voluntary, proactive steps toward protecting their groundwater source. The program also enables the Foundation to address the national need for a vital, sustainable network of communities, citizens, and successful groundwater protection strategies. The program was designed to be process-oriented, not product-oriented; inclusive not exclusive; and, most importantly, community-driven. "Community" is a broadly defined term in Groundwater Guardian and can include a city, county, watershed, corporate or college campus, or any other geographic area which relies on a common groundwater source.

A community is encouraged to enter the program no matter where it is in the groundwater protection process. Whether citizens need to begin the protection process by building community awareness or by implementing a completed Wellhead Protection Plan, they will use local expertise and resources and have the opportunity to connect with others engaged in similar activities across the country.

Community-driven involvement begins when a community requests and receives *A Community Guide to Groundwater Guardian,* the "road map" through the program. The

community then forms a Groundwater Guardian team. This team must be a diverse group comprised of representatives from citizen groups, local government, educational institutions, business and agriculture. For many communities, the team may be an existing committee or organization.

An annual entry form (included in the Guide) is submitted to the Foundation in February. The brief form asks for information about the community, its groundwater supply and problems, and how the program can help the community address these problems. Once the entry form has been accepted by the Foundation, the community team identifies existing groundwater-protection issues and develops a plan of Result Oriented Activities (ROAs) to address these issues effectively. The plan is unique to each community, but all plans must have measurable outcomes. Five areas for potential ROA development include: Education and Awareness; Pollution Prevention; Conservation; Public Policy; and Best Management Practices.

The Groundwater Foundation sends each community entered in the program a "Groundwater Guardian Community Assistance Kit," which includes information on such topics as water festivals, wellhead protection, and best management practices, and an annotated bibliography of additional resources.

Substantive progress toward planned goals will mean Groundwater Guardian designation for the community in both local and national ceremonies. Each fall, prospective and existing Groundwater Guardian communities meet at the national Groundwater Guardian Conference for the purpose of Groundwater Guardian designation, public accolades, and networking. At this conference, effective and innovative Groundwater Guardian projects are presented, and new communities recruited.

1994 served as a test year for the program. Eight communities were selected to test the Groundwater Guardian process and were designated as Groundwater Guardian communities in November of 1994. Fifty-five communities, including the initial eight, entered for 1995. Fifty of these entering communities were designated as 1995 Groundwater Guardians. This year, 98 communities have entered Groundwater Guardian, including communities from 33 states, a Canadian province, and Mexico.

Several communities have been involved in wellhead protection as one of their ROAs. Examples include:

- Memphis and Shelby Counties, Tennessee. A well monitoring program has been given a major role in the implementation and protection of the primary source of water.
- Seward County, Nebraska. Monitoring wells have been used to determine high nitrate levels in the groundwater/ drinking water supply, which led to the building of a treatment plant.
- Borough of Kutztown, Berks County, Pennsylvania. A wellhead protection ordinance was developed and enacted, establishing a Wellhead Protection Overlay District.

- Lacey, Washington. A door-to-door awareness program was established for citizens living within the wellhead protection zone.

Protecting groundwater requires an understanding of the past and a commitment to doing the right thing in the present. And, most importantly, because of the time needed to see the results of stewardship, protecting groundwater requires strong faith in the future.

Karel M. Fraser
Ohio River Valley Water Sanitation Commission (ORSANCO), 5735 Kellogg Ave., Cincinnati, OH 45228-1112, 513/231-7719

Monitoring Watersheds of Large River Systems: A Design for School Involvement

While most volunteer monitoring activities have focused on streams, lakes, and estuaries, the Ohio River Valley Water Sanitation Commission's (ORSANCO) RiverWatchers volunteer monitoring program has been developed for monitoring on large river systems, specifically the Ohio River. With a watershed that encompasses nearly 204,000 square miles, or approximately 5 percent of the contiguous United States, and has over 20 major tributary watersheds, it's obvious that the logistics of monitoring every waterway in the Ohio River Watershed are impractical for one organization.

Recognizing that tributaries and their watersheds have a great influence on Ohio River water quality, and that in 1992 there were no model volunteer monitoring programs for large river systems, ORSANCO initiated the RiverWatchers program. Five groups were selected to collect samples and conduct water quality testing on the Ohio River main stem and several tributaries. Subsequently the program has expanded to include sites along the 981 miles of the main stem and on larger and smaller tributaries in a six-state area.

During the 1995-96 monitoring year, 21 groups are conducting water quality testing at 15 sites on the Ohio River main stem and 6 tributaries. Of these groups, 20 are from elementary, middle, and high schools in counties that border the River. One group is an environmental organization. Several groups also identify macroinvertebrates. Groups are provided one of three tests kits used in the program and monitor from six to nine parameters.

One of the biggest challenges in designing the RiverWatchers program is how to evaluate the data from all the monitored waterways and find guidelines common to all. Those groups monitoring the Ohio River compare their data to established guidelines for the River. While ORSANCO conducts routine water quality monitoring on the main stem and lower reaches of several major tributaries and has historic data and established guidelines for comparison, groups monitoring on the smaller tributaries must evaluate their streams by providing baseline data, and then comparing subsequent results to the established baselines and other existing general criteria for water quality. While this is not ideal, it provides participants with the means to compare their data to others monitoring in the Ohio River watershed.

Using school groups to develop the RiverWatchers program has been beneficial in several ways. First, by incorporating water quality testing into their curricula, teachers and students provide consistent results to ORSANCO and act as watchdogs in areas where ORSANCO does not conduct routine monitoring. Next, teachers and students are introduced to the importance of clean water in their watershed and the effect of pollution on downstream watersheds. If desired, they can become actively involved in efforts to improve water quality. Finally, teachers and students can draw on the resources and experiences of ORSANCO, which has been monitoring the Ohio River and selected watersheds for nearly 50 years.

History of RiverWatchers

In 1992, ORSANCO decided to promote public involvement in water quality issues in the Ohio River Valley. ORSANCO selected five groups in three states to conduct chemical water quality testing on the Ohio main stem and three tributaries. This pilot project was launched in October, with partial funding from the Virginia Environmental Endowment.

The groups represented an adult environmental organization in Ashland, KY, a Boy Scout troop in Mt. Vernon, IN, and three school groups: a fifth-grade class from Marietta, OH; a Key Club from a high school in Lawrenceburg, IN; and a high school biology class from Rayland, OH.

Test kits were chosen for the groups based on their skill level, with elementary students receiving HACH's simple color cube school kits. Older students and the adults were provided either 6- or 9-parameter HACH Aquaculture or Fish Farming kits. All groups were given a Field Guide, developed by ORSANCO; the "Water, Water Everywhere" environmental educational three-book series; and other materials. An ORSANCO staff member visited each group and gave a brief demonstration on conducting the tests.

In the beginning, groups were asked to collect samples and test twice monthly. Results were mailed to ORSANCO for evaluation. From the parameters tested, most of the groups' results were within guidelines for the Ohio River. However, groups monitoring smaller tributaries were providing baseline data, since most sites did not have any background results to use for comparison. Data was presented in a very simple format in a newsletter.

At the conclusion of the first year, ORSANCO, with input from the groups, determined that while testing twice monthly provided a wealth of information, results did not change dramatically within that time period, and the rigorous schedule was a hardship for those groups monitoring two or three sites. However, all groups enjoyed monitoring, learned a lot about their local waterway's health, and wished to continue testing for another year. The pilot project was so successful that the Commission adopted it as one of its regular programs, and provided funding to expand into all six main stem states.

Second year

During the second year, five new groups were added to the pilot project groups, and the program included participants in five states. Groups now were asked to monitor once monthly, and one teacher took a field trip to a nearby lock and dam where ORSANCO conducted lock chamber fish population surveys. Students not only observed, but also assisted biologists in identification and measurements. One problem encountered during the first two years was that, due to budgetary restraints, ORSANCO staff were not able to have face-to-face contact with each group more than once per year. While the mail and telephone provided information exchanges, personal contact seemed to maintain enthusiasm. At the conclusion of the second year, one pilot project group lost interest and stopped monitoring.

Third year to present

Each year, ORSANCO has increased the number of participants and sites, with the greatest concentration of participants monitoring within 10 miles of the main stem. In the third year, there were monitoring sites in all six main stem states from Pittsburgh, PA, to Metropolis, IL, just upstream from the confluence of the Ohio and Mississippi rivers. Several groups conduct macroinvertebrate sampling in their local waterway. They are provided Hester-Dendy samplers ("bug condominiums" used by ORSANCO during macroinvertebrate surveys) and kick nets. During the 1995-96 monitoring year, 21 groups monitored on the Ohio River and seven tributaries. From ORSANCO's experience, the most consistent monitoring groups were from schools where teachers incorporated the program into their science curricula. Selection of future groups will focus on schools.

The biggest challenge to date has been electronic acquisition of data. Some of the groups do not have access to fax machines or computers. For the few that have the capability and equipment, results are loaded directly onto ORSANCO's bulletin board each month. Within the past several months, ORSANCO has been working on a simple program that is compatible with most computers. Those not having a fax machine or modem can put their data on disk and send it via mail. While this is not ideal, it does allow ORSANCO to load this data into databases without having to manually type in the results. Twenty-one groups monitoring monthly (approximately 3 to 9 parameters each) generate large quantities of data. ORSANCO is still trying to find the best way to graphically represent the data. Several attempts at this have resulted in a packet of graphs that are somewhat confusing, especially for elementary students.

Overall, the program has lived up to ORSANCO's expectations. More Ohio River Valley residents are increasing their awareness of water quality, and the Commission has a large database of water quality information. In several instances where results were outside "normal" water quality guidelines, ORSANCO provided further investigation into the causes. Students and teachers enjoy their outings to the waterways, and most educators believe students have a better appreciation of clean water.

Future plans for the program include linking all groups via computer so results can be shared easily. ORSANCO hopes to hold a water quality conference at which all volunteer

monitoring participants can meet and share ideas, problems, and solutions. Also, the program will add five more groups this year.

Financial restraints and staff time allotment do limit visits to each group. Ideally, groups should have personal contact with someone from the program at least twice yearly, but until additional funding and staff are available, once a year will have to suffice.

Program Roundtable B

Facilitator: **Eleanor Ely,** The Volunteer Monitor newsletter

Mac A. Callaham & Susan P. Gannaway
North Georgia College, Center for Science/Technology, Dahlonega, GA 30597, 706/864-1876

Multiagency Partnerships for Technical Support of Volunteers

The Georgia Adopt-A-Stream Program (AAS), managed by the Environmental Protection Division of the Georgia Department of Natural Resources (DNR), is three years old and involves approximately 2,500 volunteers and 100 community groups. Shortly after AAS was organized, it became clear that the one full-time employee headquartered in Atlanta could not by herself effectively serve large numbers of individuals and groups in the largest state east of the Mississippi. An advisory board was created, with representatives from such diverse groups as the Department of Community Affairs (state government), North Georgia College (university system), Association of County Commissioners, Georgia Water Pollution Control Federation, Riverkeepers, Georgia Power, Coca Cola, and community groups. This board assisted DNR in setting goals for the program. Based on the experience of other U.S. monitoring programs and the specific needs of the Georgia program, the board established three levels of involvement for volunteer groups. Initially the advisory board met monthly; now (with slightly different membership) it meets quarterly.

Because AAS receives Clean Water Act funding (319) from EPA and involves monitoring, a Quality Control/ Quality Assurance Program was required. Thus a statewide, systematic method for training, supporting, and evaluating volunteer data was also required. In conjunction with the advisory board, the college and agency personnel proposed a cooperative program with the university system to develop a network of five Regional Training Centers (RTCs) to accomplish these objectives. (North Georgia College had a prior relationship with DNR, as a result of operating a five-year-old statewide Teacher-Student Trend Monitoring Program.)

These RTCs are strategically located to include proximity to all major river basins and geologic provinces of the state. They are all based within the university system to take advantage of existing educational and scientific facilities and technical personnel. The RTCs are staffed by doctoral-level faculty who receive 2 to 4 course reassignments during a calendar year, paid for by 319 funding.

The emphasis for Georgia's Adopt-A-Stream Program is on the formation of partnerships between AAS groups and local partners, in particular local water pollution control personnel and municipal water supply operators, as well as state and federal conservation agencies, and advocacy groups. These local entities, especially in rural areas, have a high capacity for local problem solving, but a low capacity for technical training and volunteer support.

As a result of enhanced public awareness and concern regarding nonpoint source pollution problems, there have been numerous requests for assistance with the coordination and training of volunteer monitors. This project is aimed at training volunteers to aid in the evaluation of nonpoint source impacts by agriculture, construction, and urban activities.

In order to use citizen volunteers effectively, there must be an organized program in which:

1. The volunteers are trained in a consistent, systematic, and regionally convenient fashion;
2. Volunteer monitoring data can be assessed;
3. Volunteer monitors may receive professional technical support to aid in problem solving; and
4. Local entities are a part of the partnership building process.

Structure of AAS

AAS volunteers commit to a one-year project on a local water body. They begin with participation at "Level I," which consists of finding a stream site to adopt, conducting a watershed walk (mapping upstream land uses and potential water quality impacts), making visual assessments of water quality and physical habitat at one site four times per year, conducting regular litter pickups, and engaging in one public outreach activity. They are asked to report to a local partner, local government, and AAS (through their RTC). The objective is to build the volunteer's understanding of the watershed concept, the relationship between land use and water quality, positive and negative influences on water quality, and how the physical environment is important to stream life.

Levels II and III provide opportunities for volunteers to evaluate water quality or improve water quality through habitat enhancement projects. In addition to Level I activities, Level II and III volunteers choose one or more of the following: biological monitoring, physical/chemical monitoring, or habitat enhancement.

Training is required for all levels of participation.

Training trainers

Trainers need to be individuals with some depth of background in water analysis. Trainers are screened and selected by AAS and the appropriate RTC. Typical prospective

trainers include municipal employees, agency personnel (for example, Forest Service), nature center employees, and teachers. In workshops conducted by the RTCs, prospective trainers are introduced to AAS protocols, safety considerations, training manuals, and techniques. The trainers must pass the same quality assurance tests required of volunteers. They are then able to train and certify other volunteers.

Quality assurance/Quality control

At volunteer training sessions, volunteers have the opportunity to be "Quality Assured." Data collected by certified "QA volunteers" is incorporated into the volunteer data base by the RTCs.

For chemical certification, the volunteer must match the trainer's results to within 10% on tests for dissolved oxygen, alkalinity, pH, nitrate, and phosphate. The volunteers use their own equipment and the trainer uses equipment calibrated at the RTC.

For biological certification, the volunteer is observed during field collection, then must identify macroinvertebrates from a reference collection with 90% accuracy on not less than 20 organisms.

Annual recertification is required for both trainers and volunteers.

Community AAS teleconferences

Because Georgia has a GSAMS (Georgia Statewide Academic and Medical System) through which every university system and almost every public school system has an interactive teleconference system, DNR and the RTCs sponsor quarterly teleconferences in which representatives of community groups or individuals interested in starting programs can meet and confer with representatives of existing groups, RTCs, and DNR. In most cases, colleges or schools make these facilities available locally at no or low cost. The format includes a program introduction, a description of an existing program, an interactive problem-solving activity in which prospective partners identify the steps for beginning a program in a hypothetical community, and a question-and-answer session.

Annual conference and regional forums

The third annual statewide conference will be held this fall to foster group communication and networking. To date, each annual conference has been held at a different unit of the university system. About 300 participants are expected.

RTCs also sponsor an annual local forum relating to water quality in their region. The purpose of these forums is to bring together community groups interested in water-related issues. These groups are not necessarily currently involved in any AAS activity. A second purpose is to allow larger numbers of volunteers to share activities and data for their region. This is particularly important in Georgia because of the diversity of the state's geology and demography.

Daniel M. Kush
Ohio DNR, Division of Soil & Water Conservation, 1939 Fountain Square, E-2, Columbus, Ohio 43224, 614/265-6621, email:Dan.Kush@dnr.ohio.gov

Building Grass Roots Support Through Citizen Action Funding

With Section 319, Clean Water Act funds, Ohio developed a "Citizen Action Mini-Grant" program to encourage local stream, lake, and woodland protection and restoration projects. Citizen and nonprofit groups can get up to $500 for storm drain stenciling, tree or native grass planting in riparian areas, water quality monitoring, river or lake cleanups, eroding stream bank restoration, or educational trips on a creek or through a watershed. Other eligible projects include targeted public workshops, nonpoint source pollution education of public officials, and water festivals. This program is designed for minimal paperwork (one-page application) and maximum resource benefits.

The focus of the program is to fund projects that will actively involve citizens and improve water quality directly or indirectly. Nonpoint sources of pollution must be addressed by each project.

The program has $60,000, with up to $6,000 available quarterly. This allows for 120 to 150 projects to be funded. After three quarters of program operation, 35 projects have been funded. Applicants include local river organizations, land trusts, schools, nature centers, museums, health departments, university extension, watershed organizations, lake advisory councils, fishing clubs, and others. These broad-based applicants allow opportunities for almost any group to participate in NPS pollution control projects and education. Grants have allowed groups to conduct a project in a relatively short time frame: there is about a seven-week delay between application deadlines and checks being issued. The only reporting requirement is a letter of project completion.

One unique feature of the mini-grant program is that it encourages partnerships between local groups (applicants) and Ohio's 88 county Soil and Water Conservation Districts (SWCDs). The well-organized Ohio Federation of SWCDs has over 700 staff and volunteers working on conservation across the state. SWCDs may provide planning, networking, education, and technical assistance to grant applicants. It is hoped that this partnership will lead to long-term adoption and stewardship of water resources. To minimize state financial administration, grant awards are passed through local SWCDs who then pay the grant applicant.

With the success of the first year and the number of education-focused applications, the ODNR Division of Soil and Water Conservation has initiated a similar program to address conservation and environmental education needs in Ohio. This program is called the Ohio Nonpoint Source Education Mini-Grant program and will begin in September 1996 using $10,000 of state nonpoint source pollution control funds.

Mark Van Patten
Conservation Federation of Missouri, STREAM TEAM, 728 W. Main St., Jefferson City, MO 65101, 573/634-2322

STREAM TEAM...What Is It?

The state of Missouri is rich in water resources with over 56,000 miles of free-flowing streams. The waterways of Missouri are beneficial to all living inhabitants of the state, and indirectly beneficial to the nation as a whole. Missouri STREAM TEAMs strive to assist in the protection of these waters. The Missouri STREAM TEAM program, conducted under the auspices of the Conservation Federation of Missouri, is a program that organizes concerned citizens to address problems with our streams. Individually, STREAM TEAMs tackle stream problems at the local level. Collectively, STREAM TEAM members learn to monitor water quality on a geographic scale far beyond the abilities of government agencies. They also work to plant trees, stabilize stream banks, and improve fish and wildlife habitats in or near streams. Homeowners, students, landowners, and businesses are examples of the cross-section of society that STREAM TEAMs hope to continue to enlist in their efforts to conserve Missouri's greatest natural assets. Each STREAM TEAM attempts to bring together public and private resources to reach the goals of the program.

The STREAM TEAM concept grew out of a 1988 Rivers and Streams Conference that was cosponsored by the Missouri Department of Conservation (MDC) and the Conservation Federation of Missouri (CFM). The conference was attended by over 600 Missourians, and set goals for education, stewardship, and public advocacy.

In 1991, a second Rivers and Streams Conference was sponsored by the Missouri Department of Natural Resources (DNR), MDC, and CFM. There the groundwork was laid for STREAM TEAMs to begin serious efforts to monitor water quality.

The objectives of Missouri STREAM TEAM are:

1. To organize concerned citizens to address stream problems such as pollution, alteration, and general neglect.
2. To address stream issues on a local basis by involving members of the community and educating them on the importance of water quality and conservation of natural resources.
3. To draw together public and private resources to implement solutions across jurisdictional lines.
4. To help communities appreciate streams as positive assets through education and group involvement in the program.

Stream problems

Settlement and over-use have strained river resources. Over time, it becomes clear that our land use practices have changed streams, increased flooding, filled in old fishing and

swimming holes, and degraded the water quality. People readily notice trash and litter in streams and want them clean again. We all worry about the water we drink, but we are all guilty of sending wastes, chemicals, and excessive runoff into the streams.

Piecemeal solutions are frequently less effective than coordinated approaches. Real progress calls for building an understanding of the issues, involving concerned citizens, and bringing conflicting interests and political jurisdictions together. Solutions differ from one watershed to the next, and government lacks authority, manpower, and administrative flexibility to address diverse concerns in an integrated fashion.

STREAM TEAM: The solution

STREAM TEAMs organize concerned citizens to address stream problems. They act on a local basis, tackling the most manageable problems first. They draw together public and private resources and make solutions happen across jurisdictional lines.

Many STREAM TEAMs start with highly visible efforts to clean up stream litter and continue that valuable service year after year. But, in the course of that work, they become aware of and learn to address other problems. STREAM TEAMs are learning to monitor water quality. They work to plant trees, stabilize stream banks, and improve fish and wildlife habitat along streams. They talk to homeowners, school students, landowners, and businesses to explain problems found and help to solve them. They can mobilize whole communities to plan greenways, improve river access and maintenance, and remedy past errors. Perhaps most important, STREAM TEAMs help communities appreciate streams as positive assets.

STREAM TEAM: Growth and achievements

By the end of 1993, 449 STREAM TEAMs, involving over 20,000 citizens, were enrolled. Many stream inventories have been completed and local planning efforts begun. In 1993, 306 tons of trash were removed from 252 miles of river; 15,500 trees were planted; and 95 volunteer specialists were trained and equipped to monitor water quality. As a result of media coverage and heightened community awareness and interest in stream problems and opportunities, the program continues to grow.

By year end 1996, the level of active participation has jumped to over 40,000 volunteers and well over 880 teams. More than 2,000 volunteer specialists have now been trained and equipped to monitor water quality.

The STREAM TEAM program is the recipient of more than 50 national and state awards. These include a 1988 Governors proclamation of support, a 1989 and 1992 President's Environmental Youth Award, several listings on the Izaak Walton League national Honor Roll, The National Environmental Awards Committee's Searching for Success award, the Missouri Beautification Association's Outstanding Stewardship Award, the U. S. Department of the Interior's National Volunteer Service Award, selection by the federal

EPA as a featured program for volunteer water quality programs to emulate, and recipient of the National Wildlife Conservation Achievement Award.

Jennifer Myers

Oklahoma City Blue Thumb Coordinator, Oklahoma Conservation Commission, 1000 W. Wilshire, 223A, Oklahoma City, OK 73116, 405/848-4862, jmyers@occwq.state.ok.us

Oklahoma's Blue Thumb Water Pollution Education Program

The Blue Thumb program began in Tulsa, Oklahoma, in 1992 and Oklahoma City in 1994. The program is supported by EPA 319 Nonpoint Source Grants and through partnerships with local Conservation Districts (Tulsa County and Oklahoma County), the Natural Resources Conservation Service, the Oklahoma Conservation Commission, and the Oklahoma State University Cooperative Extension Service. Since its beginnings, Blue Thumb has incorporated a wide variety of programs, including:

- water quality monitoring, both surface and groundwater
- conservation education
- erosion and sediment control training
- integrated pest management training
- storm drain stenciling

Each program has brought in new partners to assist and support the Blue Thumb program's goals of improving water quality and increasing awareness of the need for conservation in urban areas.

Volunteer monitoring

Volunteer monitors make up a strong portion of the Blue Thumb program. Volunteers are asked to monitor for three reasons: (1) to determine the chemical health of a specific water body; (2) to gain familiarity with water quality testing and gain confidence in themselves as monitors; and (3) to provide information upon which the nonpoint source educational program is based.

The eight-week training course covers aquatic biology, sources of urban pollution, pesticides and fertilizers, and other topics. On-site monitoring consists of performing and recording results for the following water quality tests:

- Secchi disk depth
- ammonia nitrogen
- orthophosphates
- temperature
- nitrate nitrogen
- pH
- dissolved oxygen

- water level

Test kits were ordered from Hach, and additional supplies, such as clipboards, pencils, scissors, etc., came from local hardware or discount stores. The total cost of each complete kit is $389.76.

Air temperature, water body condition, wind speed estimate, and cloud cover are also included on the data sheet, and volunteers also perform stream habitat assessments. On the stream and reference sites, additional tests include total chlorine, total dissolved solids, and chloride. During the summer (May through September), volunteers collected water samples for fecal coliform and pesticide testing.

Working with the community

We believe that building partnerships with local, state, and federal agencies is important to further the outreach of conservation efforts. However, it is vital to have the support of residents to ensure the long-term success of the efforts. Blue Thumb has worked with a cadre of volunteers from the local community to assist with the implementation of the programs. When one of the volunteers speaks about conservation, their voice carries much further than that of a government employee. The volunteers have also contributed many hours to providing conservation education to local schools and organizations. This education will help ensure the continuation of the conservation being practiced by the residents across the state.

In the future, we hope to expand the Blue Thumb program statewide and become self-supporting.

Tina Laidlaw
Alabama Water Watch, 203 Swingle Hall, Auburn University, AL 36849, 334/844-4785

The Volunteer Monitor Coordinator: Liaison Between Citizens, Their Data, and Monitoring Programs

The concept of citizen water quality monitoring is becoming increasingly popular nationwide, with more and more citizens becoming involved in statewide monitoring programs. However, as programs grow and expand, the challenge changes from recruitment to maintenance of citizen interest. As the number of monitors increases, the potential for a citizen volunteer to become lost in the crowd also increases. This problem does not bode well for monitoring programs that depend on citizen interest and motivation. A need to retain the small-program feeling of connectedness is necessary even within larger "mega-programs."

The evolution of programs and a technique for retaining the "people component" of a program can be seen in the example of the Alabama Water Watch (AWW) program. Alabama Water Watch was created in 1992 through partial funding from the Alabama Department of Environmental Management and the U.S. Environmental Protection

Agency. The primary emphasis of the program was to collect credible data for evaluating long-term water quality trends. A Quality Assurance Officer was added to the program staff in 1994. As the number of monitors increased, so did pressures on the program staff, who felt they were beginning to lose touch with the volunteers. Several options were examined to help address this challenge: hire additional staff and divide the workload among the group; train more citizen trainers; develop regional centers; or hire a volunteer monitor coordinator. Since Water Watch's main concern was to reconnect the program with the people behind the data, the decision was made that adding a volunteer monitor coordinator (VMC) position would best suit the program's needs.

The addition of a VMC position has its advantages and disadvantages for a program. A VMC can increase the contact groups have with the program while at the same time providing them with information on monitoring efforts and water quality conditions statewide. In addition, the VMC offers the citizen monitor a renewed connection to the program "homebase." Disadvantages associated with the position (at least for a program like AWW that covers a large geographical area) derive from the fact that the VMC is not based within a particular region but is instead limited, by time and distance, in the amount of attention and support he or she can provide to each group. Building local partnerships also can be more challenging, especially when the VMC is still familiarizing him/herself with the area.

The VMC's role is to guide and nurture volunteers in all stages of their involvement with the program. From training and building partnerships to directing groups how their data can lead to action, the coordinator touches on all aspects of a volunteer's Water Watch "career." The specific means by which the coordinator can accomplish these goals vary but include following up on training workshops, helping groups build local and statewide partnerships, and assisting in data interpretation. The VMC directs his or her attention at the statewide level, meeting with monitoring groups to learn more about their local water quality issues and concerns in regard to water quality monitoring.

The "personal contact" provided by a VMC is valuable in keeping volunteers motivated, learning more about the monitor's concerns and needs, and helping to make monitors feel connected to a statewide program. Incorporating both a VMC and some type of a regional contact would allow for both greater citizen contact and greater citizen accessibility to the program. However, whatever the approach, the important issue is to ensure that the people and not just the data get incorporated into state water quality issues.

Reports from Special Discussion Sessions

Strategic Planning Session

Facilitators: **Sharon Behar,** River Watch Network; **Abby Markowitz,** Maryland Volunteer Watershed Monitoring Association
Summary report by **Barb Horn,** Rivers of Colorado Water Watch Network

The primary goal of the Strategic Planning Session (an all-day session held Saturday, August 3) was to take a step back and collectively look at the "big picture": where the volunteer monitoring movement has been, where it is going, and what are the steps to get there. Through a process of reflection, imagining, and creating a historical time-line overview, a priority list of six general topics was produced. The final product of the session was a list of tangible, realistic tasks that could assist the volunteer monitoring movement to move forward in these general areas of concern. Following are the "burning issues" that were identified for each topic, and the tangible recommendations to address those issues.

Topic #1: Building coalitions

Burning Issues:

1. building trust
2. collaboration versus competition (dealing with volunteer monitoring program "turfism")
3. reliance on EPA; what happens if EPA support ends?
4. how can "umbrella" organizations support national monitoring efforts?
5. competition for funding, influencing sources of funding (e.g., influence Congress to fund volunteer monitoring via Clean Water Act)
6. dealing with professional elitism
7. differing goals (Congress vs. environmentalists, volunteer vs. program, landowner vs. public good)

Recommendations:

1. Add a section in volunteer monitoring directory that includes strengths, skills, and what you and your work can do for others in volunteer monitoring.
2. In regional breakout discussions, address questions such as: What mutually beneficial, non-threatening collaborative opportunities exist in our region? Do we want to work together? What steps do we need to make toward collaboration? What help do we need?
3. Funders should make some grants dependent on degree of collaboration and/or provide money to create collaboration and find successful collaboration models for various levels (national, regional, state, local).

Topic #2: Improving quality assurance and data acceptance

Burning Issues:

1. how : A pertains to agency cooperation

2. improving information sharing, standardizing techniques
3. professional acceptance of data
4. getting federal/state/local agencies to use volunteer monitoring data, recognize credibility

Recommendations:

1. EPA qa/qc guidance document for volunteer monitoring programs. (Editor's note: This document was published in fall 1996 and is available from Alice Mayio, National Volunteer Monitoring Coordinator, U.S. EPA, 4503F, 401 M St. SW, Washington, DC 20460, 202/260-7018.)
2. List of potential resource groups that could provide training and other support to assist volunteer monitoring groups with qa/qc.
3. Identify data users.
4. Inventory state agencies that are using volunteer monitoring data, how they are using it, who is the contact person, etc.
5. Identify levels of data, i.e., develop a matrix matching different data-collection purposes (screening, baseline, trends, compliance, etc.) with their associated levels of qa/qc.
6. The first step is using our own data ourselves.

Topic #3: Turning data into action

Burning Issues:

1. taking responsibility as individuals and as programs
2. making a difference; translating data and citizen interest into better policy
3. lack of community organizing in conjunction with volunteer monitoring efforts
4. improve volunteers' ability to follow up on monitoring results (less "Big Brother," more local citizen action)
5. making data available; finding more and better ways to put data to use

Recommendations:

1. Find people at conference with community organizing skills, and create list of resources.
2. Make a list of key players in your local watershed and educate monitors about the decision-making process so they can decide where to plug themselves and their data into the process.
3. Keep the "action" endpoint in mind when planning training workshops, etc.; discussion should include not just data collection methods but also where the data will "end"
4. Provide programs with successful models and appropriate tools; individualize approach using model as guideline.
5. Develop menu of action-taking options, guidelines, etc., for groups to choose from, and list of resources for getting there.

Topic #4: The volunteer monitoring "big picture"

Burning Issues:

1. how organized do we want to be (or should we be) at various levels: national, regional, etc.?
2. need to increase communication in volunteer monitoring network
3. can we increase overall consistency of monitoring methods and still maintain each group's independence?

Recommendations:

1. Develop and promote positive message about volunteer monitoring; be proactive not reactive.
2. Increase communication by:
    a. updating directory, making it electronically searchable and updatable, utilizing Internet.
    b. continuing with national and regional conferences, newsletter, etc.
3. Work toward consistency of methods via tools such as manuals, articles in The Volunteer Monitor newsletter, searchable database; focus of these tools is to help groups choose methods intelligently.
4. Define research needs of volunteer monitoring community: e.g., research to assess effectiveness of volunteer monitoring efforts.
5. Help organizations not traditionally tied with volunteer monitoring to integrate monitoring with other activities.
6. Provide more opportunities to specifically discuss "big picture" issues: e.g., physical meetings with that focus only, more coverage in The Volunteer Monitor newsletter, revitalize EPA BBS, conference calls, etc.

Topic #5: Diversity

(Note: not discussed due to time constraints)

Burning issues :

1. can volunteer monitoring help people in the inner city?
2. lack of diversity in programs

Topic #6: Managing volunteers

(Note: not discussed due to time constraints)

Burning issues:

1. motivation, enthusiasm, nurturing and care of volunteers
2. high turnover

3. volunteer desire for instant gratification

Recommendations:

1. Identify where turnover is.
2. Develop checklist to be completed by coordinator and volunteer to clarify expectations, commitments, etc.
3. Help volunteers see how they fit in as stars in the grand vision.

Topical Breakouts

Educators

Facilitators: **Wes Halverson,** Colorado River Watch Foundation; **Justin Mutrux,** Raymondville School

This discussion session focused on several common problems that teachers face, along with ideas for solutions. These are summarized below:

Problem 1: **Money.** Most schools do not have the "extra dollars" for equipment.

Ideas for solutions:

- Teachers must be entrepreneurial. Try to get grants. Examples of grants: some states (e.g., Missouri) have well-established educational grant funds; Toyota Tapestry Program for innovative science and environmental programs; GTE GIFT (Growth Initiative for Teachers), $12,000 for a math/science cooperative plan.
- Sometimes local watershed management commissions, soil and water conservation groups, and local businesses can help. There are some on-line grant sources and grant-writing help. Don't be afraid to ask.
- Publicize your project. Put out a newsletter. Sell ads in the newsletter to local businesses so they can show support.

Problem 2: **Time (and time management).** Teachers are required to follow the set curriculum. Students must be ready for standardized tests. Real-world experience takes a back seat.

Ideas for solutions:

- Match your water monitoring program with state and national curriculum goals.
- Start small. Get a foothold. Things take time. Build credibility with school and community.

Problem 3: **Water curriculum.** Some teachers haven't located lessons and curricula for water monitoring.

Ideas for solutions:

- Hach and LaMotte companies provide some teacher materials.
- Field Guide for Water Quality Monitoring (published by GREEN).
- Manuals from various projects: SEARCH (Connecticut); Prairie Watch, Wetland Watch, Forest Watch (Illinois).
- Project WET, Project Wild, Project Learning Tree.
- Various online and Web sites. Be sure to look at Kentucky Water Watch site. (Editor's note: See page 19, "Water on the World Wide Web.")

Problem 4: **Burnout.** Teachers are taking "extra" time to do water monitoring. Often they have no one to help them. Burnout becomes a problem.

Ideas for solutions:

- Try getting help from retired volunteers, resource experts, business and industry, other schools, state agencies, colleges.
- Students can monitor on their own time.
- Get on line with other volunteers and teachers. Communicate. Have students make presentations to various local groups.
- Network with local groups. Use the World Wide Web to link with others across the country and around the world. Again, be entrepreneurial.
- Diversify program. Have some fun with it.

Problem 5: **Politics.** School boards are sometimes afraid that students will uncover problems on private land and the school will be blamed.

Ideas for solutions:

- Do your testing on a stream in a state or national park.
- Select a site within walking distance of school. If unavailable, monitor a land-based watershed component such as erosion, vegetation, trees.

Problem 6: **Incentives.** Teachers and students begin monitoring programs and then drop out. What kind of incentives could there be to maintain interest? How do teachers motivate students to produce high quality results?

Ideas for solutions:

- What works best: rewards to students, teachers, or schools? Often you can reach teachers through their students. Give them rewards for good work: certificates, T-shirts, caps.
- When school groups do a good job, state coordinators should send letters of praise to the principals, superintendents, and even school boards.
- Publicity.

- Diversify your program. Go beyond the standard monitoring to include other activities: trips to caves, state parks, local fishing holes.

Some other problems and issues that were mentioned were:

Irrelevance to urban population;
Overdependence on subject specialists;
Need to network with other schools in the area to share ideas, data, and equipment;
Data storage and interpretation.

Forming Statewide Volunteer Monitoring Associations

Facilitators: **Rebecca Pitt,** Maryland Save Our Streams; **Bill Deutsch,** Auburn University/Alabama Water Watch

About 20 people gathered to discuss the benefits of a statewide monitoring association. The Maryland Volunteer Watershed Monitoring Association (MVWMA) and the Alabama Water Watch (AWW) served as models for the discussion. The MVWMA's members represent federal, state, and local government agencies, nonprofit organizations, community groups, watershed associations, and for-profit businesses involved in volunteer monitoring. There are nearly 75 groups represented by the MVWMA. The AWW association consists of AWW members that participate in AWW monitoring programs.

Bill Deutsch from AWW and Rebecca Pitt from MVWMA provided overviews of their programs to set the stage for discussion. The session was mostly open dialogue among the attendees, who discussed a number of benefits of statewide volunteer monitoring associations. A statewide association can:

- serve as a support network
- serve as a clearinghouse for information
- be a source of technical advice
- provide training
- set standards for data collection and management
- provide a stronger voice for volunteer monitoring
- increase acceptance and credibility of data in the state

The Volunteer Monitor Newsletter

Facilitator: **Eleanor Ely,** editor, *The Volunteer Monitor* newsletter

Discussion topics:

1. **Newsletter evaluation.** Participants were asked to evaluate the newsletter, focusing particularly on the following questions:

- article length OK?
- particular articles especially liked or did not like?
- what do you find most useful, least useful?
- do you like the layout and design?
- is there a good balance of types of articles?

Participants agreed that the overall balance of articles is good. Each person had personal preferences: e.g., some liked the technical articles, others were more interested in advocacy or organizing: but all agreed that it's good for the newsletter to offer "something for everyone." It was also pointed out that including the more technical articles helps the credibility of volunteer monitoring. Participants expressed satisfaction with the layout and design.

It was suggested that more email addresses (for contributors, monitoring groups, etc.) be included in the newsletter.

2. **Future themes.** The following topics were brought up for group comment:
    - Restoration and Monitoring
    - Community Outreach: Organizing and mobilizing the watershed community; networking with other community groups; using media and other education tools
    - Methods and Techniques: In-depth discussion of various parameters, methods, and technical tips

    The group expressed interest in all the above themes. In response to the specific question of whether an entire issue devoted to "methods and techniques" might alienate some readers, participants said that they felt such an issue would be valuable, and of wide interest.

    Participants suggested having more articles, or possibly even an entire issue, with a coastal theme (e.g., reefs; seagrass monitoring and restoration). There were also suggestions for future articles on the following topics:

    - how to form a statewide monitoring association
    - what monitoring techniques are appropriate for what age groups
    - use of electronic communications, such as the Internet
    - Evaluation, on all levels: How to evaluate our organizations, our data, our effectiveness in the community, etc.
3. **Editorial policies**

    The following summary of existing editorial policies was provided:

A. Article selection policies and principles
    1. **Scope:** Narrow focus on volunteer watershed monitoring. Lower priority to topics that are missing any of these three ingredients.

2. **Key criterion:** Articles should provide useful information. Key question in evaluating articles: "What information can readers take from this article and apply in their own programs?"
3. **"CARDINAL RULE":** First and foremost, newsletter should serve the readers (i.e., the readers' needs and desires take precedence over those of the article writers, editor, editorial board, coediting group, or EPA).

B. Editing policies and principles (i.e., after article is accepted)
   - Don't make readers struggle: reading should be a pleasure. Avoid bureaucratic, vague, or overly technical language; strive for inviting, journalistic tone.
   - Make sure articles include plenty of practical advice and "how-to" details.
   - Encourage writers to share "failures" as well as "successes."
   - Provide resources for additional information: names, addresses, phone numbers and email addresses of contact people; lists of publications and other resources, including ordering information; addresses and phone numbers of equipment suppliers; etc.
   - Keep articles short (without losing basic message).

Participants supported the above editorial policies as useful and appropriate.

Working with Youth Groups

Facilitators: **Mark Van Patten,** Conservation Federation of Missouri; **Mandy Richardson,** Maryland Save Our Streams

What is a "youth group"?

The term "youth group" covers many different types of organizations. Participants listed the following types of youth groups and programs that could potentially be involved in volunteer watershed monitoring:

- Schools (elementary, secondary, magnet schools)
- After-school programs
- Scouts
- Campfire Girls and Boys
- 4-H
- Neighborhood groups
- Nature centers
- Service groups
- Recreation centers
- Church groups
- Juvenile centers

Issues, problems, and solutions
The discussion group discussed the following topics:

1. **Proactive recruiting**
    - Problems:

        - knowing who to contact at each group
        - volunteer monitoring groups may feel intimidated at prospect of recruiting

    - Strategies:

        - Attend meetings of Scouts, 4-H, and others

2. **Providing rewards and incentives**
    - Important to provide constant feedback
    - Rewards for teachers include continuing education credits; curriculum materials; equipment
    - Other ideas for rewards: annual special awards (can be given out at a banquet), hats and T-shirts, education vouchers, certificates
    - Sometimes companies will donate awards
3. **Providing appropriate tasks for different ages and levels**
    - More young children are participating in monitoring, but there is a scarcity of appropriate materials for them
    - Provide something for every level and ability; develop a "menu" of different tasks; add "extension" activities
    - Work with teachers who know students best
    - Make the monitoring program compatible with state performance standards
4. **Encouraging long-term commitment**
    - Be up-front with program structure and commitment
    - Do surveys to find out what volunteers want and can handle
    - Sense of ownership is critical to long-term commitment
5. **Competition with other activities**
    - Youth have lots of commitments: school, sports, scouting, etc.
    - Try to tie monitoring project in with other activities: e.g., Scout troops can set up merit badges for monitoring activities; sports coaches can require kids to do community service
6. **Motivating youth**
    - Before you start monitoring, conduct a "fun" field trip to the resource; get kids excited about the stream
    - After kids are "sold" on value of resource, begin specific study and monitoring
    - Bring local community organizers to help

Rivers and Streams

Facilitators: **Anne Lyon,** TVA; **Valerie Brennan,** Gunpowder Valley Conservancy; **Barb Horn,** Rivers of Colorado Water Watch Network

Objectives: To have participants develop a list of issues, define problems and solutions regarding those issues, and network with other volunteers.

Participants' background

There were 29 groups represented in the discussion session. Of these, 27 were engaged in biological monitoring, 28 in chemical monitoring, 28 in physical monitoring, 21 in other monitoring, 8 in instream restoration, and 6 in upland restoration.

Small group reports

We broke into three smaller groups to discuss some of the top issues facing river and stream volunteers. Each group reported back its list of the "top five" issues:

Group 1

1. Funding
2. Development of reference conditions on sites
3. Program sustainability
4. Information clearinghouse
5. Comparability of techniques

Group 2

1. Acknowledge responsible landowners/dischargers ("care and feeding of property owners")
2. Turbidity measuring
3. Public awareness (landowner septic tank education)
4. Recruiting, managing, and retaining volunteers (managing volunteers in large watersheds like the Mississippi River)
5. Action following monitoring (data to action)

Group 3

1. Consistency
2. Data sharing
3. Volunteer burnout
4. QA/QC
5. Communication of results/public legislative action

Top three issues discussed

After hearing reports from the small groups, the large group chose three topics to discuss in depth: program sustainability, data to action, and communication/education issues.

1. **Program sustainability**

Problems:

- Volunteer burnout
- Funding
- Public support
- Training
- Credibility
- Goals and evaluation
- Strategic planning
- Leadership development
- Volunteer network/communications

Solutions:

- Communication
- Get a 1-800 number
- Recognition
- Newsletters
- Provide opportunities for volunteers to network
- Give volunteers responsibilities beyond monitoring
- Create opportunities for data exchange
- Clarify reasons for volunteer monitors to communicate
- Leadership development
- Speakers' bureau
- Mentorship
- Internships

2. **Data to action**

Problems:

- Diversity of audiences; who do we want to reach?
- No goals for the data; poor planning up-front
- Data doesn't get from monitoring groups to state agency; no central data clearinghouse
- Credibility or lack of credibility of data in minds of state managers
- Mistrust of agencies and their use of data
- Too many competing environmental concerns
- Need to pool data, results, and methodologies across regions and states

Solutions:

- Foster communication through a citizens advisory committee
- Establish a "skills bank" for communication of data
- Training on monitoring program planning: including data uses and communication strategies

3. **Communication/education issues (building awareness)**

Problems:

- Unwillingness to accept personal responsibility
- Unwillingness to change values and/or behaviors
- Credibility; lack of relationships, trust
- Framing the message for the target audience
- Fear; lack of connectedness

Solutions:

- Involve more stakeholders; expand monitoring
- Media involvement
- Open communication through forums
- Flexibility in programs to address diverse needs
- Developing collaboration with other groups with similar goals
- Identifying and targeting stakeholders
- Incorporating non-monitoring events
- Resource sharing: clearinghouse (to contain recruitment tools, statewide program information and associations, how to start up, etc.)

Suggestions for 1998 conference

The group identified the following topics that we would like to see covered at the next national volunteer monitoring conference:

- Methods to expand your audience (diversity, targeting)
- School-based monitoring programs
- Human health assessments
- Data management and QA/QC
- BMPs
- Reference sites/conditions
- Relationship-building: nonprofits, volunteers, businesses, government

Also, as a general suggestion, the group felt it would be better not to have so many sessions at one time (or else to repeat more sessions).

REGIONAL BREAKOUTS

Region 1

Facilitators: **Meg Kerr,** University of Rhode Island Coastal Resources Center; **Sharon Behar,** River Watch Network

Promoting Communication Among New England Monitoring Groups

The working group recognized that many New England monitoring groups are not able to attend the national meetings. Communications networks would need to invite participation from these missing groups. The group identified five activities that could be pursued to promote a New England network, and discussed the advantages and disadvantages of each.

1. **"Generic" brochure on volunteer monitoring in New England.** The brochure would discuss in general terms monitoring activities in the region and provide a contact person for each state. It would be broadly distributed and used to educate decision makers and the general public about volunteer monitoring. The group thought the brochure would be relatively easy to produce, and it would promote interaction among groups. We would need to seek funding to get it printed and distributed.
2. **Web site for New England monitoring groups.** The Web site home page would be similar to the brochure, providing a general discussion of New England monitoring activities. It could then "hot link" to state contacts and individual program home pages. Disadvantages: (1) The Web site might not attract all the smaller groups since many do not have access to the Internet; (2) It would take time and expertise to develop.
3. **Internet discussion group.** This would provide an easy way for groups to converse and would promote information sharing. It would not help groups who don't have access to the Internet.
4. **Regional monitoring meeting.** A regional volunteer monitoring meeting could be organized in conjunction with a related meeting that is already planned. We discussed the New England NALMS meeting, scheduled for summer 1997, as a good possibility.
5. **Commit to shared projects.** Individual programs have expertise in specific areas of monitoring, but this expertise is not shared as well as it could be. The group discussed seeking funding so individual projects could "package" certain monitoring techniques in a way that would be easily accessible to all the groups.

Regions 2 & 3

Facilitators: **Rebecca Pitt,** Maryland Save Our Streams; **Diane Calesso,** U.S. Environmental Protection Agency, Region 2; and **Jay Gilliam,** VA Izaak Walton League of America

Regions 2 and 3 combined for the breakout discussion session. We discussed what volunteer monitoring programs needed as a region. Issues mentioned were funding, data management and use, and training on topics like quality assurance and volunteer management. Strategies to address these issues were discussed. The group decided that a Mid-Atlantic Conference should be held to bring the various players together to network and identify the resources we have as a region. We identified the following key groups to be brought into the planning process: nonprofit groups, government agencies (federal, state, and local levels), watershed associations, schools, businesses, and other organizations with volunteer monitoring interests.

Update: *The regions began planning the conference in October 1996. Funding has been procured to plan and conduct a Mid-Atlantic meeting in the fall of 1998. The conference steering committee includes representatives from Maryland, Virginia, West Virginia, Pennsylvania, Delaware, New York, and New Jersey.*

Region 4

Facilitators: **Anne Lyon,** Tennessee Valley Authority; **Ken Cooke,** Kentucky Water Watch

Resources available to help

Participants identified the resources in our region that potentially could help volunteer monitoring programs:

- National Estuary Programs
- TVA
- Urban programs
- Water Resources Centers
- Scientists (Auburn University)
- USACE Waterways Experiment Station
- Coke/Turner Broadcasting/Dupont/Monsanto/ Georgia Pacific/Clorox/Phillips Petroleum
- LTER Station
- EPA Gulf Breeze Station
- Gulf of Mexico Program/NOAA (relationship with Ecojustice Center)
- Tristate Committee Georgia/Florida/Alabama

What's on our plate

The groups listed the following issues that river and stream monitors are facing:

Scarcity of water
Water quality (sedimentation/poultry)
Need to focus on "citizens"
Support from agencies (leadership)
Linking data to mitigation projects
Building networks among stakeholders (agencies, groups, etc.)
Need statewide structure, standards
Institutionalize sustainability
State "control"
Volunteers expecting "action" from state agencies
"Beyond 319"
Lack of diversity; connecting with other social justice issues

Issues

We identified the following three issues of importance to participants:

1. **Funding to sustain programs:** EPA, state grants, innovative approaches
2. **Regional conference:** Do we want one? What would we like to accomplish? Possible organization of southern states into regional volunteer monitoring organization?
3. **Organizing local meetings:** What kind of support do we need?

Recommendations to epa

1. Develop or update funding source guide and user manual to help monitoring groups develop a diverse funding base
2. Pressure public officials to spend monies where designated and support community-based monitoring groups
3. EPA assistance to organize state/regional/ community-based monitoring associations
4. Continued support of The Volunteer Monitor newsletter
5. EPA fund and/or sponsor leadership training program or contract with a local group to provide regional training. Possible topics: leadership; QA/QC; programming; fundraising; monitoring protocols for rivers, streams, lakes, wetlands, estuaries, and groundwater; restoration opportunities/evaluation of restoration projects; and educating local officials.
6. EPA maintain a volunteer monitoring Web site and/or bulletin board to foster inter-regional/state/local communication (i.e., "chat session on the Net")
7. Funding for regional conferences from EPA
8. Continued full support for Alice Mayio (National Coordinator) and all of the information/support produced and provided (Volunteer Monitor newsletter; lake, estuary, and stream volunteer monitoring methods; QA/QC guidance documents; program guidance documents)
9. Recommend monitoring monies (106) be made available to citizen monitoring groups who comply with state QA/QC

Regional conference

1. **Who is our audience?**
    - Political leaders/water managers vs. monitors
    - Possible problem: monitors' limited desire to travel
2. **Focus of conference**
    - Coastal vs. inland?
    - Topical focus? Possibility of a thematic conference to focus on one set of issues, e.g., sediment, NPS issues, new protocols, policy efforts
3. **Goals of a conference**
    - establish region as a political entity
    - establish state programs
    - pool ideas and resources to host national conference
    - examine regional funding options

- expose Atlanta EPA Office to southeastern volunteer monitoring efforts
- watershed-focus working sessions - watershed management districts
- publicize local programs and accomplishments (especially to media)
- repeat workshops from national conference (e.g., QA/QC)
- develop common campaigns on key local issues (wetlands month, NPS education, etc.) and examine existing campaigns
- establish a regional event (i.e., "monitoring day")

4. **Possible topics to cover at conference**

1. coastal development
2. development in general
3. population increases
4. runoff
5. wetland losses
6. hydromodification
7. suitability of protocols and biological indices
8. biodiversity: state-of-the-art trophic indices, stream indicators (macroinvertebrate indices), and estuary indicators

At the end of the session, ten participants volunteered to form a Regional Conference Planning Committee.

Region 5

Facilitators: **Joan Martin,** Huron River Watershed Council; **Dan Kush,** Ohio Department of Natural Resources; **Libby McCann,** Adopt-A-Lake, Project WET; **Connie Fortin,** Hennepin Conservation District

The Region 5 breakout session focused on five areas which we identified as encompassing our greatest needs:

1. Program design
2. Volunteer management
3. Data quality and use
4. Funding
5. Communication and collaboration

We discussed each of these areas, developed some answers, and identified sources for further information. We felt that we could find better answers if we could continue to communicate and collaborate with each other. Therefore, we are sending a letter to the office of the EPA Region 5 from each person present at this session. Our request is to work together with someone in that office whose primary responsibility is to facilitate volunteer monitoring in Region 5. We need a central office to enable us to communicate and collaborate, to keep our resource lists up to date, and to assist us with regional workshops and meetings to be held in alternate years, beginning in 1997.

We also addressed the need to increase public awareness of volunteer monitoring. Toward that end we are preparing a press release about this national conference, which we will distribute to our local media. We will be pleased to make it available to others attending the conference.

Region 6

Facilitator: **Steven Hubbell,** Lower Colorado River Authority

The Region 6 breakout session at the conference included representatives from Oklahoma (4), Texas (9), and New Mexico (2). Arkansas and Louisiana were not represented. After reviewing program challenges and concerns, we discussed current activities that may address some of the challenges. The session concluded with recommendations for new actions that might help meet the needs communicated. The challenges and recommendations we discussed are summarized below.

Primary challenges expressed by participants:

1. Need for data management software to facilitate data exchange between monitoring programs.
2. Improved coordination and communication between programs within the region.
3. Quality assurance and training support.
4. Data ownership: some volunteers use data to address local problems without notifying program coordinators, which can lead to awkward situations in complaint investigations.
5. Volunteers lose interest; difficult to sustain long-term involvement.
6. Difficult to sustain program funding.

Recommendations to address challenges:

1. Operate in a database that can be saved as ASCII Text Delimited, which seems to be a "common denominator" in data management for the region. Exchange database information with programs that are concerned about their systems.
2. Members of the Oklahoma contingency strongly favored an EPA Region 6 volunteer monitoring conference, recommending that funding be sought from industry rather than from EPA. The Oklahoma participants agreed to contact Mike Bira (Region 6 volunteer monitoring coordinator) to discuss such a conference. The Texas Watch representative agreed to review costs from the annual statewide Meeting of the Monitors to help plan the request for financial support. Considerable discussion was devoted to the idea of

   a regional conference, with certain representatives questioning the value of such a conference, some questioning whether the regional boundaries were meaningful (favoring watershed-based gatherings), and others seeing a regional conference as an appropriate mechanism to establish meaningful networks and to highlight monitor accomplishments.

Another recommendation to address the coordination issue was to establish a Region 6 volunteer monitoring home page on the World Wide Web, with the Houston-Galveston Area Council of Government accepting responsibility for maintaining this site.

3. Recommendations to address the quality assurance and training needs include recruiting support from volunteer monitors and industry partners.
4. The data ownership issue was not resolved, though there was general agreement that local use of the data is a common goal. One solution to premature or misleading reporting by monitors may be to inform volunteers of the preferred procedures for reporting environmental complaints during the monitors' training.
5. To sustain volunteer interest, session participants suggested providing leadership opportunities to volunteers (allowing them to become trainers or quality assurance officers), offering activities beyond standard chemical monitoring (biological monitoring, site assessments, community mapping), demonstrating the value of the data by reporting on the findings, and recognizing volunteer accomplishments through special events, awards, news coverage, and invitations to speak about their monitoring work.
6. To address the sustainable funding issue, session participants suggested seeking local, private partnerships and sponsorships; making requests project-oriented; and working cooperatively to seek funding and share resources with other monitoring programs. Working with organizations such as Texas' Environmental Conservation Fund, which receives and manages donations for specific programs or projects, was also recommended.

The Region 6 breakout session concluded with an exchange of Internet email addresses and the distribution of a list of those who participated. The opportunity to interact with colleagues in the context of region-oriented discussions was enjoyable, enlightening, and productive. Bonds were established which should forward volunteer monitoring coordination in the region.

Regions 7 & 8

Facilitators: **Jeanne Heuser, Sharon Clifford,** Missouri Stream Team

EPA Regions 7 and 8 combined for the breakout session. Together, these two regions encompass 10 states: Iowa, Kansas, Missouri, and Nebraska make up Region 7 and Colorado, Montana, North and South Dakota, Utah, and Wyoming make up Region 8. At our session, representatives were present from six states: Iowa, Missouri, Nebraska, Colorado, Montana, and Utah. Of these six, only Colorado and Montana had sizable, well-established programs for volunteer monitoring.

The identified needs of the group revolved around starting monitoring programs in states that currently have small or nonexistent programs. These needs were as follows:

- Funding for monitoring programs

- Data credibility for volunteer-collected information
- Existing materials that could be used to help structure new programs

By the end of the session, participants felt comfortable with the information gained on these topics and had contacts for future use, if needed. In addition, representatives from three of the states had identified a preliminary course of action to help establish volunteer monitoring programs.

The group's long-term goal was to host a future national volunteer monitoring conference in Region 7 or 8. It was felt that hosting a conference that would be easily accessible to representatives of agencies and interested citizen groups would help bolster the effort to establish monitoring programs in the middle of the country.

Other issues of particular relevance to the participants were:

- How to turn opponents of volunteer monitoring programs into supporters. Examples of oppositional groups were landowners concerned about regulation and property rights, some state legislators, businesses, and agency staff concerned about data quality.
- Agricultural issues and rural landowners' feelings that if an agency is involved with the monitoring program, the volunteers are "out to get them."
- Dealing with citizens whose goals differ from the stated goals of the monitoring program.
- Sources of volunteers.
- Potential partnerships to help support volunteer monitoring programs.
- Methods and/or documentation of methods to ensure comparability of data within a large watershed or region.

Having clearly defined goals and publicizing those goals were emphasized as a partial solution to dealing with the first three concerns. Identifying data users and documenting data collection and quality assurance methods (developing a Quality Assurance

Project Plant) were also emphasized as ways to resolve some of the issues raised by the participants. Suggestions for partners and/or sources of volunteers were schools, fishing organizations, community and youth organizations, existing environmental groups, and agencies (e.g., state regulatory and wildlife agencies, colleges and universities, Cooperative Extension services, Soil and Water Districts, EPA, NRCS).

Regions 9 & 10

Facilitators: **Mike Rigney,** San Francisco Estuary Institute; **Joan Drinkwin,** Puget Sound Water Quality Authority

Participants identified a variety of issues that currently are hampering the use of volunteer monitoring data for watershed improvement in our regions. These issues, along with some suggestions and recommendations, are summarized below.

1. Western watersheds can be quite different from each other in both environmental and social character. These differences make it difficult to standardize approaches to volunteer monitoring.
2. Despite these differences in watershed characteristics, there is a recurring need for a monitoring "template" that could provide guidance while being flexible enough to allow local or regional adaptation.
3. Local decision-making processes and regional regulatory processes are not well integrated.
4. There is a lack of regionally appropriate protocols for volunteer monitoring at a variety of "user levels," from grade school to adult.
5. Currently there is no organized effort to establish regional working groups where ideas and techniques might be exchanged and discussed. Many suggestions: from biennial meetings for Regions 9 and 10, to listservers and World Wide Web pages: were discussed as potential solutions to this problem.
6. Traditional approaches to volunteer monitoring may be narrowly focused on particular problems or pollution sources. Instead, we need to develop a vision for what the community might ultimately want from the watershed ("What do we want to see in five or ten years?").
7. Volunteer monitors need public involvement tools that allow them to positively influence the watershed. How can volunteer monitors work "within the system" rather than being seen as "outsiders" constantly criticizing?
8. Volunteer monitoring groups need to be part of a bigger community picture that includes other civic and advocacy groups (particularly fishing groups). Volunteer monitoring alone cannot solve the problems ("We're just part of the team.").
9. Lack of funding for volunteer monitoring, particularly in Region 9, continues to make long-term monitoring program development difficult.