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Proceedings of

THIRD NATIONAL CITIZENS' VOLUNTEER WATER MONITORING CONFERENCE

Building Partnerships
in the Year of Clean Water

March 29 - April 2, 1992

AMERICA'S CLEAN WATER FOUNDATION

Alliance for the Chesapeake Bay

Proceedings of the Third National Citizens' Volunteer Water Monitoring Conference

March 29 - April 2, 1992
Annapolis, Maryland

Co-Sponsored by:
The U.S. Environmental Protection Agency
The Izaak Walton League of America
The Alliance for the Chesapeake Bay
National Oceanic and Atmospheric Administration
America's Clean Water Foundation

Conference facilitated by:
Izaak Walton League of America

Proceedings edited by:
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
WATER

On March 29, 1992, over 300 people who volunteer to monitor water quality, and representatives from federal, state, and local governments, businesses, academia, and environmental groups, gathered in Annapolis, Maryland to strengthen and build new partnerships in volunteer water monitoring. This was the third such national volunteer monitoring conference co-sponsored by the U.S. Environmental Protection Agency (EPA), and the largest to date.

The conference brought together a disparate collection of people united by their enthusiasm, talents, and desire to protect our nation's water resources. At general sessions, technical workshops, discussion workgroups and field trips, participants exchanged ideas, taught each other new techniques, and helped set future directions for the national volunteer monitoring movement.

The EPA would like to thank all those who came to Annapolis. They made the conference a great success because they were eager to share their knowledge, energy and insights. The EPA also extends special thanks to our co-sponsors -- the Izaak Walton League of America, the Alliance for the Chesapeake Bay, and America's Clean Water Foundation -- for their hard work organizing and promoting the conference. In addition, we would like to thank the members of the Conference Steering Committee listed at the back of these proceedings.

These conference proceedings are intended as a detailed reference tool. We hope they will prove valuable both to conference attendees and to anyone interested in developing a volunteer monitoring program or improving on an established program. We encourage you, the reader, to contact speakers and other conference attendees and to continue to build the partnerships we need to protect our water environment. We in EPA's Office of Water enthusiastically support volunteer monitoring efforts and will continue to provide tools volunteers can use.

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

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PREFACE

The Third National Citizens' Volunteer Water Monitoring Conference focused on how volunteer monitoring groups, businesses and local, state and federal governments can work together to monitor the quality of rivers, lakes, wetlands and estuaries.

The conference was sponsored by the U.S. Environmental Protection Agency, the Izaak Walton League of America, the Alliance for the Chesapeake Bay and the National Oceanic and Atmospheric Administration. Partial proceedings funding was provided by America's Clean Water Foundation.

The objectives of the Third National Citizens' Volunteer Water Monitoring Conference were to:

- Promote successful partnerships between governments, schools, environmental organizations and businesses;
- Teach implementation and maintenance of successful volunteer monitoring programs;
- Provide hands-on training in developing scientific monitoring methods;
- Help participants translate collected data into useful environmental education and action;
- Create an opportunity to network and exchange information with other successful programs; and
- Set the future direction for volunteer monitoring nationwide.

To encourage sharing of ideas and hands-on learning, the conference offered more than 25 workshops, panel discussions, group meetings and field trips. More than 70 conference speakers and panelists were selected for their diverse perspectives and knowledge of volunteer water monitoring. Special thanks to all the speakers, whose participation and insight enabled the conference to be a success.

These proceedings were prepared by the Izaak Walton League of America (IWLA) under cooperative agreement with the U.S. Environmental Protection Agency. The principal editor was Jacqueline Doherty of IWLA's Save Our Streams Program.

Due to space limitations, the enclosed papers were edited for length, with special care taken to maintain key points. We apologize for any inadvertent omissions or inaccuracies. It should also be noted that not all speakers provided transcripts for inclusion in these proceedings. To the majority of speakers who did provide papers, we extend our sincere thanks.

Day 1: Forming Government Partnerships

INTRODUCTION AND WELCOME

Governor William Donald Schaefer

Maryland

I would like to welcome everyone to Maryland. There's so much to see here. I hope you'll have time to see some of it, such as the wildlife, especially around the Chesapeake Bay area, and the historic sites here in Annapolis.

We have some similar interests. You are interested in water monitoring, and I want to see the bay cleaned up. In 1987, I joined governors from Virginia and Pennsylvania, and the mayor of Washington, in signing the Chesapeake Bay Cleanup Agreement. A big part of what we're trying to do with this agreement is educate the public and get more volunteers involved in restoring the bay.

We have citizen volunteers to help monitor water quality. We're lucky to have groups like Save Our Streams, Alliance for the Chesapeake Bay and the Izaak Walton League, who train volunteers to be stewards for the environment. We had 26,000 volunteers — in the rain — for our Give a Day for the Bay, Earth Day event in 1990. They planted marsh grass and trees, and picked up trash. We also have a Senior Conservation Corps who build bird boxes, plant wildflowers and other plants, and teach young people about the environment. And we have Chesapeake Cleanup Campaign coordinators helping to cleanup our parks and work on recycling.

Last year, Marylanders planted 1.5 million seedlings to help clean the air and preserve the environment. We've also got a program called Tree-Mendous Maryland.

How do we get these people involved and keep them interested? We make their volunteer activities easy and fun. You also have to make your volunteers feel their activities are worthwhile. They want to make a difference.

We all have tight budgets these days. And government can't do everything alone. We need more volunteers and more people involved in partnerships to protect our natural resources. That's why the work you do is so important.

Best of luck in your work getting more people involved.

OPENING REMARKS

LaJuana S. Wilcher

U.S. Environmental Protection Agency

A TRIBUTE TO THE NATION'S VOLUNTEER WATER MONITORS

Good morning. It is a pleasure to help you open the Third National Citizens' Volunteer Water Monitoring Conference. Let me first thank the Izaak Walton League of America and the Alliance for the Chesapeake Bay, who have been working with EPA to pull this conference together. You have done a terrific job, presenting a conference of this size and scope. We have a special thank you for Karen Firehock, who directs the Save Our Streams program at the Izaak Walton League.

This is the third conference EPA has sponsored. The first one, in May of 1988 at the University of Rhode Island, was an informal workshop of less than 50 people. Many of them went on to become leaders in the field today.

In December of 1989, 160 volunteers, organizers and program managers held the second national conference in New Orleans. In between late nights in the French Quarter they worked out the design and management of a successful volunteer program; how to control the quality of volunteer data; and how to forge links with government.

A TRIBUTE TO VOLUNTEER EFFECTIVENESS

There are 300 people here today, and there would have been more if we had the room. These conferences have really spread the word that it takes all of us working together to stop pollution. You are proof that the volunteer concept and these conferences work. I was eager to come to Annapolis to pay tribute to you, the citizens and program organizers who are truly in the trenches of the fight against pollution. I want to help celebrate your incredible dedication and enthusiasm.

We've proven that volunteers can collect high-quality data. They can work with all levels of government to make change happen. They can also educate themselves and their neighbors about water pollution issues. And, ultimately, each becomes a steward of the environment.

More than 30 states, and many local and regional governments now sponsor volunteer monitoring programs. In my own home state of Kentucky, the Division of Water manages the Water Watch Program, launched in 1985. Water Watch volunteers monitor rivers, lakes and wetlands. Their data are used for nonpoint source assessments, watchdogging or reporting polluters, and measuring trends. Kentucky Water Watch is one of the oldest and most respected state-sponsored programs.

We're also seeing lots of new programs being born. Later today we'll hear about Texas Watch, which was established in 1991 and already includes 800 volunteers.

Besides the state-managed volunteer programs, there are thousands of independent or locally managed volunteer monitoring groups in the United States today. More than 10,000 volunteers receive a copy of the EPA-funded *Volunteer Monitor* newsletter. That's 10,000 engaged, active and educated people. That's 10,000 people committed to the environment and doing something to make a difference. With each conference, we reach new audiences and build more energy to fight pollution.

PARTNERSHIPS IN FIGHTING POLLUTION

This conference is titled Building Partnerships in the

Year of Clean Water. What sort of partnerships do we mean? We mean partnerships among state, local and federal governments, private citizens, businesses and academia. We mean partnerships to share money, knowledge, data and plain old elbow grease. At this conference, you'll learn how some of the finest of these partnerships came about and how they work.

You'll also spend the next few days exploring and learning new ways to collect stream critters, manage databases and motivate volunteers. Some of the most capable and experienced experts in the field will speak, but so will you. We want you to share your knowledge, ask questions and help define the needs and future goals of the nation's volunteer monitoring movement. Your ideas and perspectives are essential to make this conference a success.

DEFINING WET WEATHER RUNOFF

About two weeks ago, EPA sent Congress our report on the quality of the nation's rivers, lakes, estuaries, coastal waters and wetlands. It summarizes what the states know about their water quality, and it is our best way to report that information to our lawmakers and the public.

The 1990 report is sobering. It tells us, that despite the progress we have made controlling pollution from sewage treatment plants and industries, we still face enormous challenges. We still have areas closed to fishermen because the fish are contaminated by PCBs, mercury or dioxin. There were more than 1,000 fishing restrictions in the country in 1990. States reported 300 beach closures because of high bacteria levels, and there were probably many more.

We still have beaches closed to swimming. We still have rivers that can't support fish, and lakes overgrown with pernicious vegetation. States found these sorts of problems in fully one third of the waters they monitored. By far the most common reason for these problems is *wet weather runoff.*

If the term is new to you, let me tell you what I mean by wet weather runoff. You'll be hearing it a lot at EPA's Office of Water. When it rains or snows, water flows across the ground and picks up a lot of pollutants. The biggest load by far is dirt. The wet weather runoff washes silt from eroded stream banks, construction sites and farm fields. The waters also carry fertilizers and pesticides from croplands, and the bacteria from animal grazing areas. The runoff gathers the weed and bug killers people spray on their lawns and shrubs, and the oil your neighbor put down the storm drain after tuning her car. The wet weather runoff collects the dirt, oil and used hypodermic needles from city streets and parking lots, and flows on, carrying its burden of soil and heavy metals and filth.

Where does the wet weather runoff go? Through storm drains or over the ground, the water goes into streams. Streams feed into rivers which empty into lakes or coastal estuaries. At every stop along the way, wet weather runoff leaves some of its poisonous burden behind. It kills the life in our waters. It grows noxious plants that suck the oxygen from the water and suffocate beneficial plants and fish. It makes the waters unsafe even for swimming.

The states tell us that agricultural runoff creates more than half of the pollution problems in rivers and lakes. In estuaries, sewage treatment plants continue as the biggest problem, followed by runoff from storm sewers and urban areas.

SOLVING THE PROBLEM OF POLLUTION FROM WET WEATHER RUNOFF

EPA is working with state and local governments, and non-government organizations to tackle these pollution problems. The federal government has spent more than $65 billion in the last 20 years to upgrade and construct municipal sewage treatment plants. We've imposed increasingly stringent controls on industrial discharges. And we're waging war on wet weather runoff on a variety of fronts.

We began awarding state grants to implement approved nonpoint source pollution control programs in 1990, and, as of this fall, we will have awarded $140 million worth. Last June, under the Coastal Zone Act amendments of 1990, we proposed new guidelines for reducing nonpoint source pollution in coastal areas. We're pushing hard to implement the 1989 National Combined Sewer Overflow Strategy, and we have established major new stormwater regulations.

But it isn't enough for EPA to implement regulations, award grants and propose guidelines. There is more to be done than EPA or your state agencies can do. Citizens have to become involved, as you have.

Volunteer monitors help our water bodies in two major ways. The report I just mentioned is based on data states collected for 36 percent of total U.S. river miles, 47 percent of lake acres, and 75 percent of estuarine square miles. That's a substantial increase over previous reporting, but it still leaves a large percentage of our nation's waters unmonitored.

Volunteer monitoring data have proven their usefulness and reliability. We know we can use volunteer data right along with the information water professionals gather. Some states use volunteer data to identify potential problems for detailed study. In other states, volunteers collect valuable information on waters the states don't have resources to monitor. We know as long as they follow good quality-control procedures and are well trained, volunteers can gather a lot of the information we need to make vital water quality management decisions.

EDUCATION AND STEWARDSHIP

Citizen volunteers also help improve our water quality through their stewardship. As citizens learn how to monitor, they learn about water pollution. They learn how everyday actions — things as basic as putting fertilizer or pesticides on their lawns, or used oil disposal — can affect the waters in which they fish and swim. They become involved in protecting water quality and they raise their voices against polluters.

It is only by joining in partnership with citizen-stewards can EPA and other government and non-government organizations effectively beat the problems of wet weather runoff.

When we talk about effective volunteers, I think of a story about a woman walking along a beach at sunrise. Ahead she could see a young girl playing at the water's edge. When she reached the child she saw that she was picking up starfish, one by one, and tossing them into the sea. The woman asked why, and the girl replied, "The tide is going out, and if the starfish are left here when the sun rises, they will die."

"But there are thousands of miles of beach," the woman said, "and millions of starfish. How can what you're doing really make a difference?"

The girl smiled as she bent over, picked up another starfish and tossed it into the waves. "It makes a difference to this one," she said.

You are good stewards. Thank you for what you are doing. Keep on doing it, please. EPA cannot do its job without you. I assure you that EPA will be here and will continue to support you in the years to come.

Thank you.

FEDERAL AGENCY ROLES

Panelists: Dave Davis, U.S. Environmental Protection Agency; Jeffrey Anliker, U.S.D.A. Soil Conservation Service; Don Duff, U.S.D.A. Forest Service; P. Patrick Leahy, U.S. Geological Survey; Gary Rosenlieb, National Park Service; Trudy Coxe, National Oceanic and Atmospheric Administration; and Neil Carriker, Tennessee Valley Authority.

Dave Davis

U.S. Environmental Protection Agency

THE EPA ROLE IN VOLUNTEER MONITORING

EPA has been actively involved in supporting the nation's volunteer monitoring movement since 1988, when we co-sponsored the first national conference in Rhode Island. We also co-sponsored the second conference in New Orleans and this Annapolis conference.

In addition to sponsoring conferences, EPA's role traditionally has been to develop national-level guidance and other products to support the movement, and to advocate the use of volunteer data by state and local governments. Various EPA grant programs such as Section 319 (nonpoint sources) and Section 314 (clean lakes) also support state-level volunteer monitoring programs.

We recognize that some volunteer groups are primarily educational in focus: their great value lies in increasing their knowledge about water and creating a sense of stewardship among volunteers and those they reach. Other groups are more scientifically oriented and become trained in quality control methods to generate data managers can use. Both types of groups are invaluable to EPA. We need good data because states can't monitor everywhere, and we need good citizens who understand their environment and work to protect it.

EPA's activities to support volunteer monitoring are managed primarily by two divisions within the Office of Wetlands, Oceans and Watersheds (OWOW) and by the 10 EPA regions. I'll talk for a minute about this organizational sharing of responsibilities, briefly mention some of EPA's volunteer monitoring activities and products, and close with some words about future directions.

EPA STRUCTURE AND RESPONSIBILITIES

First of all, we're strengthening our volunteer monitoring programs at EPA, both at the headquarters and regional levels. We still have a long way to go and hope to learn from this conference how we might best support the movement.

EPA's 10 regional offices offer a limited degree of technical assistance to volunteer monitoring organizations, primarily through our Environmental Services Divisions, who are our lab and science folks. Staff in our Water Management Divisions often assist in program coordination and outreach. Some regions have already taken a leadership role.

For example, our Region 10 office in Seattle recently sponsored its own regional volunteer conference, developed a streamwalk protocol to assess riverine habitat, and coordinated with the vast number of volunteer groups in the Pacific Northwest.

EPA does not spend a great amount of resources in monitoring water quality itself. Rather, EPA gives the states grants for water monitoring and pollution control programs; our regional offices and the states develop agreements on what those programs should look like. Many regions are now

including volunteer monitoring as a condition to be negotiated in these state/EPA agreements.

At the headquarters level, the Assessment and Watershed Division is responsible for overall water-quality monitoring and assessment, and is taking a leadership role within the office on volunteer monitoring. The Oceans and Coastal Protection Division supports volunteer monitoring for coastal and marine waters. The Wetlands Division provides outreach and information on the value and function of wetland resources.

OWOW VOLUNTEER MONITORING PRODUCTS

OWOW has worked with grantees to develop the following products to support volunteer monitoring programs:

- *Directory of National Citizen Volunteer Environmental Monitoring Programs.* We've put out three editions and are planning a fourth. We feel this is a handy reference tool because it includes a bit of information about each program and includes contacts. (Grantee: Rhode Island Sea Grant/University of Rhode Island)
- *Volunteer Water Monitoring: A Guide for State Managers.* This publication runs through the steps needed to plan, implement and maintain a volunteer monitoring program. The document was targeted to skeptical state managers, and we feel it has had a significant impact on illustrating how quality-controlled data can be generated by trained volunteers. (Grantee: The Alliance for the Chesapeake Bay)
- *Volunteer Lake Monitoring: A Methods Manual.* Recently printed, this manual illustrates methods for lake volunteer monitoring on a step-by-step fashion. This is the first of our methods manuals; we have one for rivers under development and one for estuaries in planning. (Grantee: Jon Simpson, formerly of NALMS)
- *The Volunteer Monitor.* This friendly, informative newsletter for volunteers has a circulation of 10,000. (Grantee: Eleanor Ely)
- Citizens in Environmental Monitoring. The proceedings from Volunteer Monitoring Conferences co-sponsored by the EPA.

We also publish various outreach and information exchange tools such as our newsletters — *Nonpoint Source News Notes, The Water Monitor, Coastlines* (a computerized nonpoint source bulletin board) and a wetlands hotline.

FUTURE DIRECTIONS

We want to learn from you what sorts of help you think EPA can provide the volunteer movement. Our own plans are to continue developing methods manuals, continue supporting the *Volunteer Monitor* and the fourth edition of the directory, and continue encouraging state use of volunteer data through a variety of approaches.

For example, our guidance to states for the preparation of the biennial state water quality assessment (305 b) reports identifies volunteer data as a legitimate source of information. Grants under EPA's Clean Lakes, Nonpoint Source, National Estuary Program and Near Coastal Waters Program encourage citizen participation and support volunteer monitoring.

We will continue to sponsor workshops and conferences at the regional and national level; we will continue to strengthen our liaison with other federal agencies and encourage their activities in support of volunteer monitoring; and we will continue to establish a clearinghouse of information related to volunteer monitoring.

Despite EPA's enthusiasm about volunteer monitoring, however, our approach needs to be integrated into the larger picture. It is important to remember:

1. Volunteers may collect excellent data, but they don't replace the professional biologists and chemists in state water quality agencies. Volunteer data serves best when it screens for problems in areas the professionals can't get to and alerts them to possible problems. Budgets are tight all over, and we don't want states to get the message that they can disinvest in monitoring because volunteers will do all the work for them.

2. Volunteer monitoring programs are cost-effective, but they aren't free. Anyone who decides to set one up should be committed to maintain it, to fully support and train the volunteers, and to manage and use the data they generate.

We in EPA's Office of Water also emphasize some resource protection activities that place even more importance on volunteer monitoring in our scheme of thinking:

- Geographic Targeting: We don't have the resources to monitor or manage every water segment in the country, so we need to identify and target for action our priority problem areas for protection. Volunteers can help.
- Watershed Protection Approach: We need to think in ecosystem terms, to monitor and manage whole watersheds with all their interconnected resources. Volunteers can help.
- Habitat: We need to act on a principle we all recognize; that without its habitat, no animal survives, least of all man. And that aquatic and terrestrial habitats must be monitored and protected to ensure good water quality. Volunteers can be especially helpful in monitoring habitat conditions and surrounding land uses.

In summary, EPA has actively supported the volunteer montioring movement for years and will be strengthening that support in years to come. If you would like to receive a copy of any of the publications mentioned, or learn more about EPA's volunteer monitoring program, call or write Alice Mayio, Volunteer Monitoring Coordinator, USEPA/OWOW, WH-553, 401 M St., SW, Washigton, DC 20460; 202-260-7018.

Jeffrey G. Anliker

U.S.D.A. Soil Conservation Service

THE EARTH TEAM VOLUNTEER PROGRAM

Earth Team, the volunteer program of the U.S.D.A. Soil Conservation Service (SCS), presently has over 8,500 volunteers donating 400,000 hours in more than 1,600 SCS offices throughout the country. SCS, with more than 3,000 local offices, provides many opportunities for volunteers to actively support the improvement of natural resources in their local communities. Earth Team volunteers provide many services to SCS such as administrative, education information, technical and professional. Earth Team volunteers receive worker's compensation and tort claims liability protection and in many instances, reimbursement of expenses.

Nationally, SCS concentrates on the following Earth Team initiatives:

1. Environmental Education: Using volunteers to provide materials, training and instruction to educators and students.
2. Residue Management: Using volunteers to provide information, training and field measurement of residue cover to farmers; hosting field tours and public relations activities to increase the amount of residue on agricultural land to decrease erosion and runoff.
3. Organizational Outreach: Developing memoranda of understanding (MOU) with other agencies and organizations for educating employees and members of the need for proper resource management and how to implement practical solutions to local resource problems. Presently, MOUs have been signed with EPA, Ruritan National, and the National Council of Catholic Women. SCS is working on developing MOUs with the Izaak Walton League of America, the General Federation of Women's Clubs, the National Association of Civilian Conservation Corps Alumni, and many others.
4. Water Quality: Using volunteers for information and educational activities, presentations, taking water samples, doing nonpoint source and wetland inventories, and evaluating irrigation systems.

With the focus of this conference on water quality, I want to stress that SCS, in at least 10 states, is using volunteers for water-quality activities in support of state or local interests. The states I know

use Earth Team volunteers for water-quality activities include Alabama, California, Indiana, Maine, Minnesota, Ohio, Rhode Island, Texas, Virginia and West Virginia.

SCS cooperates with the Extension Service (ES) and the Agriculture Stabilization and Conservation Service (ASCS), all within the United States Department of Agriculture, on special water quality areas. This effort includes establishing 74 hydrologic units and 16 demonstration areas throughout the country. In these identified special water quality areas, SCS and ES are providing increased technical capabilities to offer additional assistance to landowners/users. ASCS provides accelerated federal cost-sharing for the implementation of conservation or management practices that reduce water quality problems.

In summary, I want to match our technical expertise and local delivery system with your organization to actively pursue a volunteer effort to implement water quality monitoring where needed. The results will guide our country's future water quality efforts. For additional information, call 1-800-THE-SOIL.

Don Duff

U.S.D.A. Forest Service

PARTNERSHIPS FOR AQUATIC RESOURCES

The Forest Service has implemented a program that involves working with natural resources on America's National Forests, National Grasslands and National Recreation Areas. These resources involve habitats on some 128,000 miles of waterways, 2.2 million acres of lakes and 16,500 miles of coastline, which amounts to about 50 percent of all trout and salmon habitat in the United States. It involves more than 3,000 kinds of fish, wildlife, plants, and some 140 threatened and endangered species, all on unique terrestrial or aquatic habitat on National Forest System Land (NFS).

The program also involves water quantity and quality resources on watersheds on National Forest lands. These watersheds provide over 173 trillion gallons of water annually to maintain their dependent resources as well as water for downstream economic uses. Some 42 million acres of municipal watersheds are being managed on NFS lands, and more than 50 percent of the surface water supply of the western United States originates on NFS lands.

A resurgence of partnerships developed at the urging of concerned citizens and conservation groups looking for a better, more visible fisheries habitat management program within the Forest Service (FS). These citizen monitoring programs defined the role of citizens in meeting agency management goals for aquatic ecosystems, fisheries and water quality.

With the support and urging of concerned conservationists, the U.S. Congress initiated the Challenge Cost-Share Program on National Forest System lands in 1986. It is designed to facilitate and encourage direct public involvement in managing National Forest habitats. The program involves cost-sharing, in dollars, services and equipment, with interested individuals, groups and agencies, for specific habitat improvement activities. These partnerships can involve matching monies, labor and equipment, or sharing technical skills. But in all cases, the results are direct, on-the-ground habitat improvement to benefit wildlife, fish, people and America.

The Forest Service started with 57 partners in 1986 and increased partnerships to 867 in four years. In 1989, the FS and its partners completed 5,028 habitat improvement structures, enhanced some 131,660 acres of habitat and completed 82 inventories, reports and surveys for fish and wildlife habitats. The program has been so successful that it grew from $2.5 million in 1986 (partner at 64 percent and FS at 36 percent contributions) to more than $15.8 million in 1989 (partner at 60 percent and FS at 40 percent).

For example, Trout Unlimited (TU) and FS formed a partnership agreement in 1987 which joined more than 50,000 citizen fishing enthusiasts

in 465 chapters throughout the United States for the purpose of maintaining and enhancing the productivity of coldwater habitats on National Forests. The goal was to improve trout and salmon populations and provide for the best interests of the American public.

Since the TU/FS agreement, local and regional partnership agreements have been affected in 20 states (20 TU Councils with 71 National Forests). These agreements cover habitat work on more than 90,000 stream miles (71 percent of NF stream miles) and over 785,000 acres of lakes (36 percent of NF coldwater lake acres).

In addition, TU has become an effective partner in lobbying Congress for increased funding for the FS Rise to the Future Program. Due in part to TU efforts, the Forest Service's budget of $5.6 million in fisheries for fiscal year 1986 increased to $27.8 million for fiscal year 1990. Fisheries biologist positions within the FS also rose from 113 in 1986 to 220 in 1989.

To improve coordination between the two groups, a FS fisheries biologist was assigned to Trout Unlimited as national partnership coordinator, which was the first time a partner cost-shared in a full-time position with the Forest Service. The FS has assigned employees to work with states and professional societies before, such as the American Fisheries Society, but this was the first time a formal arrangement was made with a volunteer group. The position helped facilitate more effective communication and technology transfer between TU and FS. Another key benefit was increased dialogue between TU chapters and National Forests in managing coldwater fisheries habitat resources, resolving conflicts and establishing opportunities for increasing involvement in projects between the two groups. Involvement is a key item, and the proof is on the ground; the partnership works.

In 1986 a total of 1,700 fisheries structural improvements were installed by TU and other fish partners. In 1987, that number rose to 3,100 structures, an increase of over 80 percent. In 1989, 68 percent of the FS structural habitat improvement program was for anadromous and inland fish species (4,000 structures). This work was accomplished by our partners who donated their time, manpower, equipment and supplies which matched or exceeded FS appropriated funds.

FS initiated an Adopt-A-Stream program for TU and other partners to focus on specific habitats and fish species of interest. The program enables the public to have a voice in the management of their resources on National Forest System lands. Some TU chapters have adopted streams outside their local area. Some eastern and mid-western TU chapters are even considering adopting a western stream, and planning family vacations around that project effort.

Partnerships work at all levels as more citizens and public agencies become concerned about resource management. The following are suggestions on how to structure partnerships to the mutual benefit of everyone concerned:

1. Establish early involvement and communications in all aspects of project planning, construction and monitoring.
2. To have good partners, be a good partner. Show interest, establish dialogue, give ownership and build a level of trust and integrity between partners.
3. Be receptive to new and innovative proposals. NO is a bad word if you wish to be sensitive to new resource user needs.
4. Understand your partner's missions and goals, and how it meshes with your agency's objectives.
5. Outline desired future conditions for habitat and fisheries so all have a clear understanding of where you are going and how to get there.
6. Develop good proposals with concrete results to meet objectives and provide tangible, achievable benefits.
7. Present well-planned proposals and provide more information if requested.
8. Provide recognition to partners through high profile public relations.
9. Build active internal and external support networks.
10. Leverage funds to the maximum extent feasible. Provide for commitment and account-

ability to the partner in all budget and planning aspects of a project or program.

11. Target news media to communicate ideas to potential new partners. Project yourself into new markets—you have an attractive, sellable product. Take risks to achieve the desired product rather than adopting a business as usual attitude.
12. Build on successes and learn from mistakes. Be positive, cultivate a winner attitude. You never fail until you stop trying.

The Forest Service is actively seeking more citizen involvement through CMPs on NFS lands for the monitoring and management of these important aquatic ecosystems and water-related dependent species. For more information on how your group can become actively involved in National Forest resources management, contact any of the following regional fisheries program managers for your geographic area:

CONTACTS FOR USDA FOREST SERVICE PARTNERSHIPS FOR AQUATIC RESOURCES

- Northern Region: Contact Rick Stowell, Program Manager, Wildlife and Fisheries, USDA Forest Service, Federal Building, PO Box 7669, Missoula, Mont. 59807; 406-329-3520.
- Rocky Mountain Region: Contact Gordon Sloane, Program Manager, Range, Wildlife, Fisheries and Ecology, USDA Forest Service, Rocky Mountain Region, 11177 West 8th Avenue, Box 25127, Lakewood, Colo. 80225; 303-236-9536.
- Southwestern Region: Contact Jim Cooper, Program Manager, Wildlife Management, USDA Forest Service, Federal Building, 5127 Gold Avenue, S.W. Albuquerque, N.M. 87102; 505-842-3264.
- Intermountain Region: Contact Don Bartschi, Program Manager, Fisheries and Wildlife Management, USDA Forest Service, Federal Building, 324 25th Street, Ogden, Utah 84401; 801-625-5666; or Fred Mangum, Regional and National Aquatic Ecologist, USDA Forest Service, Macroinvertebrate Laboratory (for Biological Water Quality Monitoring) 105 Page School, BYU, Provo, UT 84602; 801-378-4928.
- Pacific Southwest Region: Contact Lynn Decker, Program Manager, Fisheries and Wildlife Management, USDA Forest Service, 630 Sansome Street, San Francisco, Calif. 94111; 415-705-1158.
- Pacific Northwest Region: Contact Dave Heller, Program Manager, Fish and Wildlife Management, USDA Forest Service, 319 S.W. Pine Street, PO Box 3623, Portland, Ore. 97208; 503-326-4091.
- Southern Region: Contact Cindy Wiliams, Fish and Wildlife Management, USDA Forest Service, 1720 Peachtree Road, NW, Atlanta, Ga. 30367; 404-347-4082.
- Northeastern Region: Contact Robert W. Hollingsworth, Program Manager, USDA Forest Service, Room 500, Milwaukee, Wis. 53203; 414-291-1749.
- Alaska Region: Contact Jack Capp, Fish and Wildlife Management, USDA Forest Service, Federal Office Building, Box 21628, Juneau, Alaska 99802-1628; 907-586-8752.
- Washington Office: Contact Harvey Forsgren, National Fisheries Program Manager, or Cindy Deacon Williams, Assistant National Fisheries Program Manager, Wildlife and Fisheries Management, USDA Forest Service, 14th N.W. Auditor's, P.O. Box 96090, Washington, D.C. 20090-6090; 202-205-0830.

P. Patrick Leahy and Norman Schmidt, Jr.

U.S. Geological Survey

VOLUNTEER FOR SCIENCE PROGRAM

The U.S. Geological Survey (USGS) initiated the Volunteer for Science Program in June 1986 as a way for members of the public interested in the

earth sciences to meet President Bush's challenge to "serve others and enrich your community" as one of his "thousand points of light." The Volunteer for Science Program is a companion effort to the Federal Government's Take Pride in America Program, coordinated by the Department of the Interior. Take Pride in America is a national public awareness campaign to encourage the public to become stewards in preserving the nation's natural and cultural resources. The focus of the campaign is on volunteer activities by individuals, organizations and communities in caring for their public lands and resources. The motto of the USGS is "Earth Science in the Public Service." There is perhaps no better way to meet the spirit of this motto than to establish and foster a program of volunteer service within the USGS.

Since its inception, the Volunteer for Science Program has benefited from the efforts of more than 3,000 people who have donated thousands of hours of valuable service. The USGS estimates that volunteers have saved the federal government more than $6.6 million since the program began. Among the 3,000-plus volunteers are students and faculty from about 200 colleges and universities, and 68 elementary and secondary schools.

Each volunteer must prepare a written agreement describing his or her individual time commitment and the services to be performed. Volunteers under the age of 18 require the written consent of their parents or guardians. Volunteers need not be United States citizens. The purpose of the program is to give volunteers an opportunity to become stewards of the nation's resources by working side by side with the nation's largest earth-science research organization. Volunteers are involved in a wide array of activities such as assisting in geologic and hydrologic investigations, collecting water-resources data, providing computer support for the analysis of information, performing administrative support, assisting with library and map archival services, and reviewing technical manuscripts. Some recent examples of services provided by volunteers in support of water-resources investigations include:

- General hydrologic data collection in Alaska;
- Field assistance on the Grand Canyon Water-Quality Study;
- Collection of water samples to study geochemical processes;
- Servicing water-quality mini-monitors in Texas;
- Providing laboratory support for the analysis of organic and inorganic constituents;
- Sampling stream bed and bank material, sampling and identifying plant species; and
- Sampling sediment and organisms from the bottom of San Francisco Bay.

An emerging opportunity for volunteer involvement is the USGS National Water-Quality Assessment Program (NAWQA). The NAWQA Program began in 1991 following a successful five-year pilot effort to test and refine assessment concepts. The goals of the NAWQA Program are to describe the status and trends in the regional water quality of a large representative sample of the nation's ground-water and surface-water resources, and to develop an understanding of the natural and human factors affecting the quality of these resources. This information will provide a sound scientific basis upon which water-resource decision-making at all governmental levels can be based and improved.

The NAWQA Program is designed to be perennial and consists of rotational and comprehensive water-quality investigations in 60 key areas of the nation representing a wide array of climatic, hydrologic and land-use settings. The study areas include major regional hydrologic systems (river basins and aquifers) each covering 1,200 to about 50,000 square miles. All study areas will be sampled for a national set of water-quality characteristics consisting of a common set of physical measurements, inorganic constituents and organic compounds. The data will be collected and quality assured using a prescribed set of national protocols. Information will also be collected to define the characteristics of aquatic biological communities to relate these characteristics to the physical and chemical properties of streams, and to define the biological processes that affect water quality in a particular setting. Key findings from the NAWQA Program will be used along with other information to provide issue-oriented

water-quality assessments of regional and national interest.

In summary, the USGS currently has an active Volunteer for Science Program that is providing a valuable service to the nation. In water resources, volunteers are active in the collection, compilation, interpretation and reporting of hydrologic data. The recently implemented NAWQA Program has the potential for future volunteer involvement because of its multi-disciplinary scope and national coverage.

Gary Rosenlieb

National Park Service

OPPORTUNITIES FOR VOLUNTEERS WITH THE NATIONAL PARK SERVICE

Volunteers have historically provided important contributions for the protection and resource management activities of the National Park Service (NPS). Countless hours have been donated by volunteers representing national organizations such as the Student Conservation Association, Rotary International, Kiwanis Clubs, local school organizations and friends of the parks groups. These volunteers construct and maintain trails, collect litter and refuse, and monitor a wide variety of resource conditions. In today's world of decreasing budgets for natural-resource management programs, many parks could not function without the valuable assistance of volunteers.

The NPS manages a wide variety of water resources where water quality is an especially critical attribute that must be managed, protected and preserved. Maintenance of clean water is an especially important goal at all of the NPS recreation areas and national seashores where body contact recreation is a major use of the water resource. Many parks are responsible for the management of aquatic habitats that contain endangered or threatened species, such as the sea manatee that migrates through estuarine habitats managed by Canaveral National Seashore. Water quality monitoring is a vital tool for the management of sensitive water quality dependent environments, and opportunities abound in the nation's parks for volunteer involvement in water quality related monitoring programs.

VOLUNTEER WATER QUALITY PROGRAMS

The monitoring protocols of certain volunteer water quality organizations have been incorporated into at least one park's student educational outreach program. Using the techniques of the Izaak Walton League's Save Our Streams Program, rangers at Harpers Ferry National Historical Park have been instructing local sixth grade students in the techniques of biological monitoring on tributaries of the Potomac River. The data that is collected by the students is compiled and forwarded to the Izaak Walton League and the West Virginia Department of Natural Resources.

One of the park's more successful volunteer programs related to water quality is being conducted under the auspices of the National Park Marine Debris Program. In this cooperative effort with the National Marine Fisheries Service, volunteers conduct technically sound beach surveys of the human-generated debris that wash up on the beaches of National Park Service units. Eight geographically disparate parks and national seashores are participating in this program: Cape Cod, Assateaque Island, Cape Hatteras, and Canaveral National Seashores represent the northern-southern Atlantic coastal area; Gulf Island and Padre Island National Seashores represent the Gulf of Mexico; and Olympic and Channel Islands National Parks represent the Pacific Coast. Quarterly beach surveys conducted by volunteers in these parks recorded a total of 113,722 debris items in 1989-1990.

VOLUNTEER OPPORTUNITIES

With the advent of numerous volunteer groups that are solely devoting their efforts to water quality monitoring, the National Park Service offers a spectrum of fresh water, marine and estuarine environments in which to work. Needless to say, most parks could use the services of a competent group of

local volunteers to collect quality assured, quality controlled data in a standardized, systematic and consistent fashion. Many parks have existing objective-driven water-quality monitoring programs which could use the services of volunteers. Other parks are facing significant water quality issues and are now in the initial stages of implementing major water quality monitoring programs with state and federal agencies. Coulee Dam National Recreation Area and Assateaque National Seashore are two examples of programs where citizen volunteers are needed.

The Coulee Dam National Recreation Area (CODA) offers an opportunity to become involved in a cooperative study of significant water quality issues that are impacting aquatic life and are international in scope. Located in the upper Columbia River Basin, CODA is responsible for many aspects of the administration of Lake Roosevelt, an 80,000-acre reservoir that was created by the construction of the Coulee Dam. Lake Roosevelt provides opportunities for numerous forms of water-based recreation, including sport fishing for rainbow trout, white sturgeon, perch, kokanee and walleye. Unfortunately, recent studies sponsored by the Washington Department of Ecology have found that sediment and fish in Lake Roosevelt are seriously contaminated with heavy metals and chlorinated species of dioxin and furan. This has required the posting of health advisories on Lake Roosevelt and the Columbia River that warn the public to limit their consumption of flesh from certain species of sport fish that are captured from the river and lake.

As a result of these water quality problems, federal (including the NPS) and state agencies with responsibilities for management of the lake, and private citizens groups have formed the Lake Roosevelt Water Quality Council which has obtained $500,000 from Congress for the purpose of conducting a comprehensive water quality evaluation of the lake. The investigation will be conducted by the U.S. Geological Survey. The project proposal adopted by the Lake Roosevelt Water Quality Council calls for the formation of a cadre of trained citizen volunteer water-quality monitors that will collect physical, chemical and biological data on the Columbia River and Lake Roosevelt.

Assateaque Island is the only undeveloped barrier island within the state of Maryland and the northern most island within the chain of islands off the Virginia coast. Although Assateaque and its adjacent waters are not totally free from human disturbance, park resources are relatively pristine and are being managed in such a fashion that natural conditions are being restored. Bay waters to the west of the island are important nurseries for aquatic species and provide recreational opportunities for millions of people each year. Threats to the integrity of the water quality around Assateaque Island are pervasive and increasing in both number and complexity, with contaminant sources consisting of runoff from urban and agricultural areas which lack central sewage treatment facilities. These sources threaten to degrade the bay waters for both aquatic habitat and recreational uses.

To address the magnitude of potential problems, park staff initiated a water quality monitoring program in 1987 that measures several chemical, physical and biological parameters in Chincoteaque Bay and the surf water along Assateaque Island. Overall, park personnel are collecting monitoring information at 13 stations, with each station sampled seven times annually. Interpretation of the information from this program indicates a need to continue the monitoring program for the next several years. The park is seeking energetic volunteers that are interested in conducting bacteriological sampling in surf waters and potentially to assist with some bay water quality monitoring.

Trudy Coxe

National Oceanic and Atmospheric Admininstration

VOLUNTEER MONITORING OF COASTAL WATERS

The Coastal Zone Management Act of 1972 (CZMA) established the first national program to

promote the protection and wise use of the nation's coastal areas, which extend over 95,000 miles and border three oceans and the Great Lakes. Administered by the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management (OCRM), the CZMA established a voluntary program through which states receive technical assistance, policy guidance and federal matching grants to develop and implement programs aimed at more rational management of the nation's coastal resources. These state programs must address important concerns, such as the protection of valuable natural coastal resources, improved coastal water quality, better management of development in coastal hazard areas, enhanced public access to the coasts, and improved coordination of government activities. To date, 29 of 35 eligible states and U.S. island territories have received federal program approval and are implementing their coastal management programs. These programs, which cover 94 percent of the nation's shoreline, are unique in their comprehensive approach to managing our nation's valuable coastal resources.

The CZMA also established a national system of estuarine research reserves to assist states in acquiring and managing estuarine areas. More than 300,000 acres of estuarine lands and water are currently being protected by OCRM. In the coming years, an additional 300,000 acres will be protected. The estuarine research reserves provide field laboratories for studying the natural and human processes that affect estuaries so that stresses on these highly biologically productive areas can be minimized. These areas, which are chosen to reflect regional differences and a variety of ecosystem types, are primarily used for long-term scientific and educational programs that provide information essential to coastal management decision-making.

Under the CZMA, OCRM has funded a variety of state efforts to establish citizen monitoring programs as part of the coastal zone management (CZM) and estuarine reserve programs. For example, state CZM programs have funded efforts to get citizens involved in water quality monitoring, beach cleanups, adopt-a-beach programs, and community education projects. These volunteer programs have provided valuable information on the quality of the nation's coastal lands and waters, and have served to heighten public awareness of the sensitive nature of these resources and the need to protect them.

In the Chesapeake Bay region, CZM program grants funded efforts to institute a network of citizen monitoring programs in Maryland, Virginia and Pennsylvania. To date, there are over 30 sites being monitored by volunteers in these states. Several water quality factors are recorded by the volunteers, including water and air temperature, pH, water clarity, salinity, dissolved oxygen and nitrate nitrogen. Data collected through these volunteer programs are entered into the Chesapeake Bay Program database at the Regional Computer Center, where they are available to all bay program managers.

A volunteer monitoring program has also been established along Alabama's gulf coast using CZM funds. Alabama's Department of Economic and Community Affairs, and Department of Environmental Management joined forces with the Dauphin Island Sea Lab to establish 25 citizens' water-quality monitoring stations. Concerned about declining water quality in the state's bays, volunteers at these stations regularly monitor dissolved oxygen, salinity, secchi depth, water temperature and rainfall. Known as the Baywatch Program, this volunteer effort includes participants in both Mobile Bay and Perdido Bay. Baywatch also has its own newsletter to report tips, results, basic science, training and membership news.

Volunteer citizen monitoring programs have also played an important role at the nation's estuarine research reserves. At the Chesapeake Bay National Estuarine Research Reserve in Virginia, volunteers have conducted estuarine debris cleanups on a quarterly basis. The data gathered during these cleanup events are reported to the Center for Marine Conservation, which sponsors the National Marine Debris Database, a national network of volunteers who participate in beach cleanups and use standard data cards to record information on types and quantities of marine debris collected. The cleanup events at the Chesapeake Bay Reserve have taught volunteers

about problems facing our estuaries, explained how their work will help in the search for solutions and provided general knowledge about the environment.

A citizen's monitoring program has operated at the Narragansett Bay National Estuarine Research Reserve in Rhode Island since the fall of 1988. The Prudence Conservancy provides the volunteers for this effort, which includes a study of atmospheric deposition of nutrients to Narragansett Bay, a quantitative investigation to determine the available groundwater on Prudence Island, and a marine monitoring program to determine water quality at seven stations along the coast and salt marshes.

These are just a few examples of the types of volunteer monitoring programs that have been established with assistance from CZMA grants. These volunteer efforts have proved to be a cost-effective way of tracking the quality of the nation's coastal waters. They have also been valuable for increasing community awareness of coastal water-quality protection and gaining public support for management tools.

In the future, there will be an even greater need for citizens to participate in monitoring programs. The 1990 Amendments to the Coastal Zone Management Act created a new program that requires states and U.S. island territories with federally approved CZM projects to develop coastal nonpoint pollution control programs. The program's purpose is to develop and implement management measures for nonpoint source pollution to help restore and protect coastal waters from adjacent land uses.

Implemented by NOAA and EPA, management measures to reduce polluted runoff from nonpoint sources include buffer zones around streams and coastal waters, density limits which can be applied to adjacent land development, improved construction standards, erosion and sedimentation controls, and farming and pesticide management. NOAA is also reviewing the landward boundary of state coastal programs and will recommend changes needed to control nonpoint pollution in May.

Coastal states have until November 1994 to develop their coastal nonpoint pollution control programs for approval by NOAA and EPA. Funding for this effort is limited, and states will need to rely increasingly on volunteers to implement their programs. Volunteers can help by monitoring existing water quality and documenting the relative effectiveness of various management measures to reduce nonpoint pollution over time; information that will enable managers to make the most cost-effective decisions.

Neil E. Carriker

Tennessee Valley Authority

CITIZEN VOLUNTEERS FOR WATER QUALITY MONITORING

The Tennessee Valley Authority (TVA) currently uses citizen volunteers to collect water quality data in three monitoring projects. These are:

1. A Teacher/Student Water Quality Monitoring Network (T/SWQMN);
2. A cooperative project with the Western North Carolina Alliance (WNCA) surveying stream conditions in selected watersheds; and
3. A Citizen Water Quality Monitoring Network (CWQMN) collecting data on conditions in embayments of several TVA reservoirs.

The three projects illustrate different approaches to citizen involvement in water resources monitoring. This paper will focus on those variations and discuss some of their strengths and weaknesses from TVA's point of view.

TEACHER/STUDENT WATER QUALITY MONITORING NETWORK

The primary objectives of TVA's Teacher/Student Water Quality Monitoring Network is the collection of low-cost water quality data and incorporation of water resource management concepts into school science curricula. Secondary benefits include increased public awareness of the value of

water resources, career development opportunities for participating teachers, and stimulation of student interest in environmental management careers.

The approach includes four key elements: teacher recruitment, basic training, teacher-directed studies and rewards for participation. The program is aimed at high school science teachers and students, with competitive selection of eight new teachers each year. Each teacher brings two students to a fall training workshop, where they join 16 other teacher/student teams who already have completed one or two years in the program. Water resources and environmental education specialists from TVA and the University of Tennessee at Chattanooga organize and conduct the workshop. Workshop topics include basic instruction on stream ecology, water chemistry, hydrology, study design and safety planning. Each new team also receives a chemical water quality test kit.

After returning to their schools, each team incorporates some of the water resources concepts from the workshop into a curriculum unit, selects a local water body for study, develops and implements a study plan, and records their results for publication in a T/SWQMN yearbook. Early the next summer the teams attend a one-week Water Camp where they receive additional training and exchange information on their field and classroom experiences. The school that performs best in a Water Quality Olympiad is awarded a monitoring instrument, and the teachers and students whose overall performance in the program is judged best receive a plaque designating them as Teacher or Student of the Year. Depending on available funding, teachers may be selected to make presentations at national professional meetings.

WESTERN NORTH CAROLINA ALLIANCE WATERSHED PROJECT

TVA's primary objectives in the WNCA project are to obtain low-cost data useful in identifying resources to protect or problems to address, and to increase local awareness of and participation in water resources management. Studies currently are underway on the upper 400 square miles of the Little Tennessee River watershed near Franklin, North Carolina, and on Spring Creek and Laurel River, which have a combined watershed area of about 200 square miles near Hot Springs, North Carolina.

The project is conducted by the WNCA under a contract with TVA. TVA provides funds for locally based project leaders selected by the Alliance. In addition, TVA provides training on sampling procedures, analysis of invertebrate samples, and consultation on study design and data analysis. TVA publishes annual reports prepared by the project leaders. The Alliance identifies a professional biologist, ecologist or engineer who is qualified and interested in conducting a stream and watershed study. The project leader identifies and reviews available information, designs the study, recruits citizen volunteers, directs and performs the field work, prepares annual reports, and makes presentations to civic and community groups, schools and others.

To date, over 200 volunteers have assisted the project leaders in sample collection, organization, report preparation and other tasks. Biological and riparian land use surveys have been completed for essentially all streams in the upper Little Tennessee River drainage basin and have been started in the Spring Creek/Laurel River basins. Subwatersheds in the Little Tennessee basin have been prioritized for water quality improvement efforts, and substantial community support has been mobilized for resource protection and improvement.

CITIZEN WATER QUALITY MONITORING NETWORK

Objectives of the CWQMN are to develop information on water quality conditions in reservoir embayments to supplement TVA's own monitoring efforts and to educate participants about both the dynamic nature of reservoirs and TVA's role in reservoir management. Because of the number of TVA reservoirs, it is impossible to routinely include embayment stations in TVA's reservoir water quality monitoring program. The CWQMN provides useful information on temperature, dissolved oxygen and water clarity in embayments that would otherwise be unavailable.

Working with lake user associations, TVA recruits lakeshore residents, dock operators and fishermen to serve as citizen water quality monitors. Each participant is trained in equipment use and receives a temperature and dissolved oxygen meter, a secchi disk and postage-paid forms for reporting results. Participants select one or two stations to monitor biweekly from May through September. Most stations are located near the centers of large embayments, but the TVA-developed list may include a few main reservoir stations.

TVA compiles and analyzes the results mailed in by participants. Each year results are summarized in a report specific to the reservoir and are used to supplement analysis of TVA's reservoir monitoring data. Five reservoirs currently have one or more CWQMN participants collecting data.

EVALUATION AND PROGNOSIS

Each of these projects illustrates a slightly different approach for involving local citizens in water resources monitoring. In all three cases the citizen volunteers have been enthusiastic and capable, and have produced high quality data. Results have been useful to TVA and to state agencies in evaluating conditions in Tennessee Valley streams and lakes. As a result of these projects, several hundred private citizens have participated in water quality monitoring and a number of them have become effective advocates for better water resources management.

The only data quality problems have been due to the quality of the instruments provided to the CWQMN participants. In an effort to reduce costs, TVA purchased temperature/DO meters that proved to be unreliable. There have been a few participants in each project who fall well below the standards established by their peers in producing useful results, but they constitute a small percentage overall — a proportion probably similar to the underachievers in the ranks of professional water resource specialists.

The most significant problems TVA has encountered with its citizen volunteer water quality monitoring projects are underestimating the amount of staff time required, and allowing other, often unscheduled, work to divert staff away from managing these projects. While that problem is not likely to disappear completely, as the value of volunteer monitoring programs becomes more obvious, the agency will likely commit adequate staff resources to the job and resist the temptation to divert assigned staff to other work.

STATE AGENCY PARTNERSHIPS

*Presenters: Alan Stokes, Association of State and Interstate Water Pollution Control Administrators; Joe Bachant, Missouri Department of Conservation; Dave Buzan, Texas Water Commission; Mike Arcuri, West Virginia Division of Natural Resources; and Scott Kishbaugh, New York State Department of Environmental Conservation.**

Alan Stokes

State and Interstate Water Pollution Control Administrators

STATE OF THE STATES: VOLUNTEER MONITORING EXPANDS NATIONWIDE

The following national report was presented by Alan Stokes, State and Interstate Water Pollution Control Administrators, and researched by Karen Firehock, Izaak Walton League of America.

The idea of using volunteers to monitor water quality is not new. In the early 1970s participants in the Maryland Save Our Streams Program, initiated by the Izaak Walton League of America, were conducting biological monitoring using simple indicator macroinvertebrates to determine evidence of impairment of state rivers. Since these early days, groups such as the Alliance for the Chesapeake Bay and others have become active in supplying the state of Maryland with vital data on the quality of its lakes, wetlands, rivers and the Chesapeake Bay. In the early 1970s the Izaak Walton League spread the idea of volunteer monitoring nationwide using the water wagon, a large mobile lab which visited every state (except Alaska and Hawaii) lecturing to as many as 2,000 people a day on monitoring water quality. The Water Wagon retired after a year with 130,000 miles accumulated.

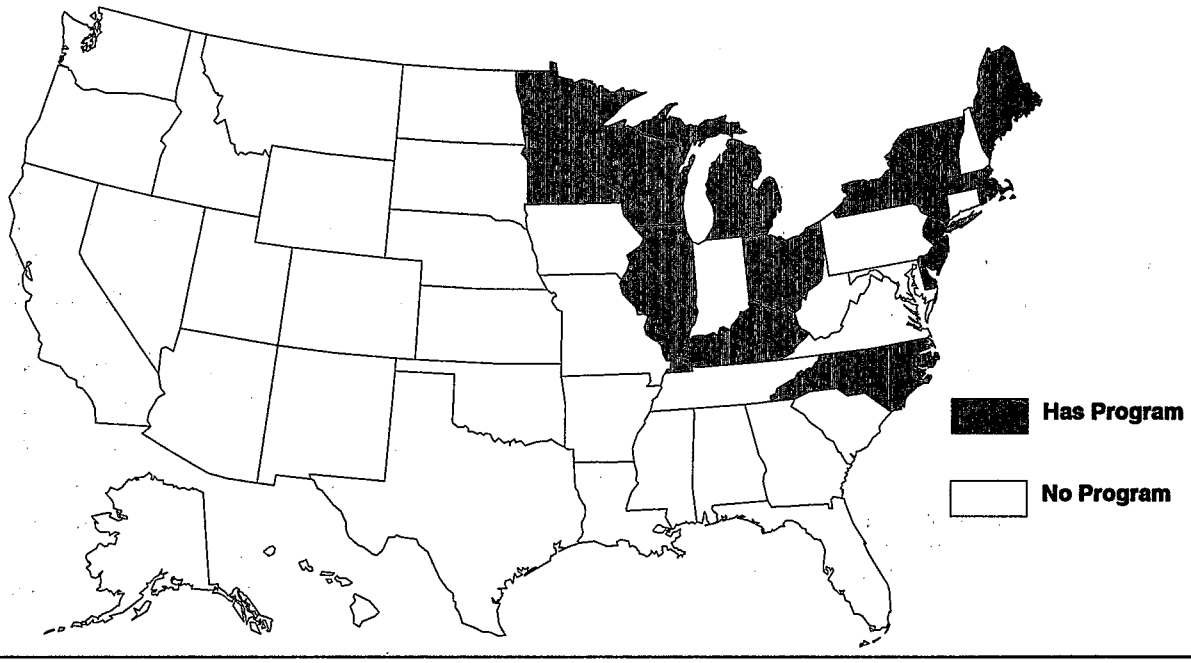
Since then, volunteer monitoring programs have been springing up around the country as states have realized the vast resources of volunteer energy available to monitor, assess and restore America's waters. Organizations such as schools, environmental organizations, civic groups, government at all levels — federal, state and local — have realized that volunteers can effectively monitor waters using scientific, reliable methods to produce high quality data on the condition of surface waters. These monitoring projects have become even more critical as additional water assessment requirements are placed on states while budgets are becoming tighter. In addition, with only 36 percent of America's rivers and 47 percent of lakes currently being monitored by government programs, more information is needed to adequately assess pollution problems. Volunteers can fill the gaps in monitoring programs and focus extra attention on problem areas.

The following list reflects our current knowledge of state-managed volunteer monitoring programs. Virtually all states have independent or locally-sponsored programs. Many of these groups are currently working to encourage their state environmental agency to begin a volunteer monitoring program and/or work with existing projects.

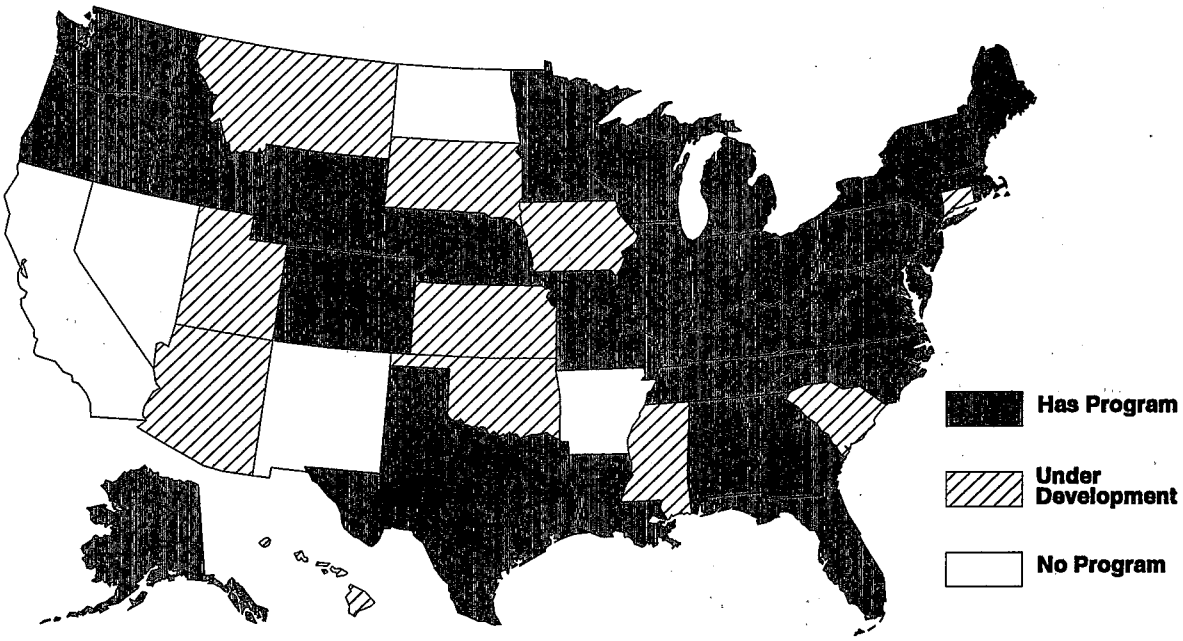
To date, 33 states have initiated statewide monitoring programs. The following chart provides a brief overview of monitoring programs in various states:

**Transcript Unavailable*

STATE MANAGED VOLUNTEER MONITORING PROGRAMS, 1988



STATE MANAGED VOLUNTEER MONITORING PROGRAMS, 1992



State	State-Run Program	Coordinating Agency	Water Types
Alabama	Alabama Coastal Cleanup	Alabama Department of Environmental Management	Coastal
	Perdido Bay Volunteer Monitoring Program	Alabama Department of Environmental Management	Estuary
	Baywatch	Alabama Department of Environmental Management	Estuary
Alaska	Alaska Water Watch	Alaska Department Environmental Conservation	Rivers Lakes Wetlands
Arizona	Under development	Arizona Department Environmental Quality	
Arkansas	none		
California	none		
Colorado	Rivers of Colorado	Colorado Division of Wildlife	Rivers
Connecticut	Under development		
Delaware	Delaware Stream Watch	Division of Water Resources DNREC	Rivers
D.C.	Under development		
Florida	Florida Lakewatch	Florida Department of Environmental Regulation	Lakes
Georgia	Adopt-A-Stream	Georgia Environmental Protection Division	Rivers
Hawaii	Under development		
Idaho	Citizens Volunteer	Idaho Division of Environmental Monitoring Program Quality	Lakes River
	Streamwalk	Idaho State University	Rivers
Illinois	Volunteer Lake Monitoring Program	Illinois Environmental Protection Agency	Lakes
Indiana	Volunteer Lake Monitoring	Department of Environmental Management	Lakes
Iowa	Under development		
Kansas	Under development		
Kentucky	Kentucky Water Watch	Kentucky Division of Water	Rivers Lakes
Louisiana	Louisiana Beachsweep	Office of Litter Control and Recycling	Coastal
Maine	Volunteer Lake Monitoring Program	Maine Department of Environmental Protection	Lakes
	Maine's Voluntary Anglers	Department of Inland Fish and Wildlife	Rivers

State	State-Run Program	Coordinating Agency	Water Types
Maryland	Adopt-A-Stream	Maryland Department of Natural Resources	Rivers
	Chesapeake Bay Citizens Monitoring Program	Maryland Department of Natural Resources	Rivers Estuary
Massachusetts	Adopt-A-Stream	Mass. Division of Fisheries and Wildlife	Rivers
	Acid Rain Monitoring Project	Mass. Division of Fisheries and Wildlife	Rivers Lakes Wetlands Estuaries
Michigan	Self Help Water Quality Monitoring Program	Department of Natural Resources Land and Water Management Division	Lakes
Minnesota	Citizen Lake Monitoring Program	Minnesota Pollution Control Agency	Lakes
	Minnesota Clean Rivers Project	Minnesota Department Natural Resources	Rivers
Missouri	Missouri Stream Team Lake Citizen Monitoring Program	Missouri Department Conservation Missouri Department of Natural Resources	Rivers Lakes
Mississippi	Under development		
Montana	Under development		
Nebraska	Volunteer Lake Monitoring Network	Nebraska Department of Environmental Control	Lakes
Nevada	None		
New Hampshire	New Hampshire Volunteer Lake Assessment Program	Department of Environmental Services	Lakes
New Jersey	Waterwatch Environmental Protection	New Jersey Department of Lakes	Rivers Wetlands Estuaries
	The Clean Lakes Program	New Jersey Department of Environmental Protection	Lakes
New Mexico	None		
New York	New York Citizens Statewide Lake Assessment Program	New York Department of Environmental Conservation	Lakes
	Adopt A Water Body	New York Department of Environmental Conservation	Lakes
N. Carolina	N. Carolina Stream Watch	N. Carolina Division of Water Resources, Department Natural Resources	Rivers
N. Dakota	None		

State	State-Run Program	Coordinating Agency	Water Types
Ohio	Stream Quality Monitoring	Ohio Department of Natural Resources	Rivers
	Citizen Lake Improvement Program	Ohio Department of Natural Resources	Lakes
Oklahoma	Under development		
Oregon	Salmonid Trout Enhancement Program	Oregon Department of Environmental Quality	Rivers
	Clean Lakes Program	Oregon Department of Environmental Quality	Lakes
Pennsylvania	None		
Rhode Island	Watershed Watch Program	Department of Environmental Protection	Lakes Rivers
S.Carolina	Under development		
South Dakota	Under development		
Tennessee	Tennessee Save Our Streams	Department of Health and Environment	Rivers
Texas	Texas Water Watch	Texas Water Commission	Rivers Lakes Estuary
Utah	Under development		
Vermont	Milfoil Watcher's Program	Department of Environmental Conservation	Lakes
	Lake Lay Monitoring	Department of Environmental Conservation	Lakes
Virginia	Virginia Save Our Streams	Department of Conservation and Recreation	Rivers
West Virginia	West Virginia Save Our Streams	West Virginia Division of Natural Resources	Rivers
Washington	Citizen Lake Monitoring Volunteer Monitoring	Washington Department of Ecology Puget Sound Water Quality Authority	Lakes Estuary
Wisconsin	Self-Help Lake Monitoring Program	Wisconsin Department of Natural Resources	Lakes
Wyoming	Wyoming Association of Conservation Districts Volunteer Monitoring Program	Wyoming Department of Environmental Quality	Rivers Lakes

* Under development reflects states which have begun planning for a state-coordinated volunteer monitoring program.

Information contained in this report is from the national database of the Save Our Streams Program called Monitors. Contact the Save Our Streams Program of the Izaak Walton League of America for additional information on any of the projects mentioned in this report.

Joseph P. Bachant

Missouri Department of Conservation

A VIEW FROM THE WATERSHED: MISSOURI'S HOLISTIC RIVER PROGRAM

Missouri is a stream state with more than 56,000 miles of warm and cold water streams. The quality of these resources has steadily declined over the past century due to land clearing, channelization, pollution, impoundments, diversions and other abuses. Over 5,000 miles of streams have been channelized and an additional 2,920 miles are affected by the permanent and flood pools of mainstream reservoirs.

Missouri's citizens first became alarmed at the declining condition of their river resources in the late 1960s and early 1970s when it seemed that every remaining free-flowing stream had at least one proposed major dam project. The 1970s and early 1980s were a period when all efforts focused on stopping or altering massive federal water projects. While these efforts were largely successful, a tunnel-vision mentality resulted, which prevented many people from seeing rivers as large complex systems.

During the last decade, however, natural resource scientists and managers began to see the need to examine all the river basin parts to better understand the whole. Required impact analyses of a wide range of activities demanded a keener insight to cause and effect relationships on a watershed level. This new science is rapidly evolving on many fronts and is confronting the professional worker with the problem of keeping up with the literature in several different disciplines. Unfortunately, many concerned citizens have not had the opportunity to gain these new insights.

In 1986, the Missouri Department of Conservation created a comprehensive river conservation program called Streams for the Future. Basic aspects of this program include training department and allied agency personnel in the scientific/technical functions of riverine ecosystems, including their watersheds. The Department's approach to river problems is holistic in nature and geared to applying solutions from the top of the watershed down. For example, Missouri has sustained massive topsoil losses. Restoration of viable river systems is not feasible until the uplands within affected watersheds have corrective land-use practices installed.

Another fundamental cornerstone of the program is to raise public awareness of river/watershed problems, especially as they affect areas of public concern such as water quality, fish and wildlife, and recreation. An important subset of the public awareness effort is to create a new constituency for river conservation with a broader vision than a decade or more ago. One approach to seeking, informing and involving this new constituency is through our Missouri Stream Team program. Our goal is to find potential leaders and educate and empower them to become better resource advocates.

One of the first tools created for accomplishing this education is a subjective environmental assessment called the Stream Team Inventory. This simple survey instrument causes laypersons to look at seven basic parameters of stream health: watershed, riparian corridors, streambanks, stream channels, fish and wildlife, scenic features and water quality. Introductory training is available, though the assessment was designed to be self-explanatory. The main goal was to force people to begin thinking holistically.

Advanced inventory training planned for the near future will dwell in detail on the seven parameters, but with a focus on the context of its influence or interaction with each of the other parameters.

Based on our experience, initial training for a watershed assessment should be very basic. Most persons are familiar with their address on a political boundary basis (city, state), fewer on a ecological basis (great plains, prairie), but hardly any person can geographically place themselves on a watershed basis.

In addition to map reading and similar basic skills, most laypersons will have to learn to read the landscape. For example, major land-use activities such as clear cutting or subdivision construction may easily draw attention, but the cumulative effect

of sheet soil erosion within a watershed can be even more damaging and easily overlooked. Crash courses in soils, vegetation and landforms such as karst will also be needed. Once these skills are mastered, sampling strategies can be devised to help observers rate watershed conditions. Then and only then do we believe that valid judgements on watershed condition can be generated by the concerned public.

Our goal is to cultivate a true partnership with these new constituents. In addition to generating a common ground of concern for our state's water resources, this partnership must also prosper on a common wealth of knowledge. Training and education are the clues. Professional knowledge must be effectively transferred to the private sector if a new era of informed resource concern and advocacy is to arise.

As a former governor from the state of Oregon recently said in a meeting similar to this, "Political action is the project of public opinion, and public opinion is the product of informed individual action."

Learning to understand broader landscapes such as watersheds yields a holistic view to the nature of river and water quality problems. This insight then suggests the stewardship and advocacy opportunities open to each individual. When this is achieved, perhaps the day of positive political action on major land-use issues will be at hand.

Dave Buzan

Texas Water Commission

THE TEXAS WATER COMMISSION IN PARTNERSHIP WITH CITIZENS

In the fall of 1988, the Texas Water Commission (TWC) held a series of public meetings to discuss massive fish kills along the Pecos River. One purpose of the meetings was to recruit support for a citizen's monitoring program along the river.

Fish kills began on the Pecos River in the fall of 1985 and were repeated during the fall of 1986 and 1988. Each kill lasted for several weeks and included hundreds of miles of river. The three kills resulted in more than 2.5 million dead fish. The only known cause of the fish kill was identified as a microscopic plant (alga) that under certain unknown conditions created an extremely toxic environment in the river. This alga, named *prymnesium parvum*, had never been found in the United States before.

The Texas Water Commission faced several problems associated with the Pecos River fish kills: Investigating the kills was difficult because of the extreme remoteness of the river. The local community did not know who to contact about the kills and was distrustful of the agency. In addition, technical questions remained unanswered regarding the physical and chemical conditions that were creating the toxicity in the river.

The TWC did not know what weather or water quality conditions caused the alga to bloom. Why were massive toxic alga blooms occurring when there was no documentation of prior problems? Also, it was unknown to what extent, if any, oil and gas production activities might be contributing to the kills. Since the major industry in the area was oil and gas production, the public believed those industries were in some way responsible for causing the kills. TWC's explanation that toxic alga caused the kills and that there was no known practical way to control it was met with great skepticism by the public.

The need for more information about the Pecos River and improved communication with the local commmunity was obvious. Attempts to meet those needs would eventually lead to the creation of Texas Watch and its volunteer monitoring programs.

The Texas Water Commission first became actively involved in citizen monitoring in May 1988 when an agency representative attended a national conference on citizen monitoring held in Rhode Island. Upon his return from Rhode Island, he suggested setting up public meetings to describe the cause of the fish kills and to recruit volunteer monitors. The goal was to train volunteers who

could collect samples for algal analysis and be able to make basic observations about the river.

Pecos River volunteers first met and began sampling the river in May 1989. The volunteers included ranchers, retirees and members from local industry. By March 1992, they had collected over 450 sets of measurements from nine sites. The samples showed that the blooms had occurred during each of the three fall seasons since volunteers began monitoring the river, but that the blooms had not been toxic. During the same time, TWC collected about 30 samples from four sites on the river. Whether by providence or design, the Pecos River has not suffered any major fish kills since the implementation of the citizen's monitoring program.

From the beginning of the plan to use citizens, TWC's mid-level administration reflected typical concerns about state involvement with volunteer monitors. Administrators were fearful that the public would express anger about TWC to their legislators because the state was asking volunteers to help do something the agency was getting paid to do.

In addition, there were no funds or other resources set aside for working with volunteers. There were no public, state or federal directives requiring the agency to work with volunteers, and TWC's potential liability if volunteers were injured was an added concern. Finally, some administrators felt working with volunteers would be time-consuming and not yield any worthwhile information.

In the spring of 1990, TWC established an interagency task force to evaluate the potential roles of the agency with respect to volunteer monitoring. The task force recommended that the Texas Water Commission take an active role in supporting and developing citizen monitoring programs. The task force concluded:

1. Volunteer monitoring was already happening in Texas and was going to grow throughout the state with or without the participation of the Texas Water Commission. As the agency charged with protecting water in the state, TWC should be in a position to work positively with groups that wished to do volunteer monitoring.

2. Participation in these programs is not free. The agency would need financial and physical resources to support volunteer monitoring.

3. There were considerable advantages to involvement in volunteer monitoring. Other programs had shown that volunteer monitoring information can be of acceptable quality and can be used to improve management decisions. Working with volunteers was also an opportunity to better understand public needs and public perceptions, as well as gain public support for TWC regulatory and management decisions and improve public awareness of environmental issues.

The task force recommended that the Texas Water Commission provide a broad level of support for citizen monitoring, establish a centralized coordinator's office within the Field Operations Division, designate field coordinators within the district field offices, organize statewide and local volunteer monitoring committees, and create a technical advisory committee composed of various agency representatives. The task force applied for a Lake Water Quality Assessment grant from the U. S. Environmental Protection Agency in order to begin supporting citizen monitoring.

Receipt of the Lake Water Quality Assessment grant allowed creation of Texas Watch in February 1991. Our experience since then shows that the rapidly growing demands of the public are quickly outstripping the program's current resources. There is a great deal of public interest in participating in these types of programs.

Texas Watch is currently placing emphasis on developing collaborative efforts with other agencies, cities and some industries that provide direct support to volunteer monitoring groups around the state. These partnerships will help improve support for volunteer groups that are widely separated geographically. It will also encourage other agencies and organizations to experience the positive benefits of working with the public through volunteer monitoring.

The Texas Water Commission has also launched a new initiative, Clean Texas 2000, that will provide recognition for businesses that support environmental activities such as volunteer monitoring.

Mike Arcuri

West Virginia Divison of Natural Resources

CITIZEN MONITORING IN WEST VIRGINIA

Citizen water quality monitoring started in West Virginia in 1989 when the Izaak Walton League of America (IWLA) signed a memorandum of agreement with the State Division of Natural Resources (DNR) for the purpose of establishing IWLA's Save Our Streams Program.

From DNR's point of view, the benefits would be two-fold. First, it would increase environmental awareness among the state's citizens. Second, it would provide baseline data for streams which had rarely or perhaps never been sampled previously.

DNR felt that the SOS biological monitoring approach would suit its needs because the state was primarily interested in obtaining information on nonpoint source (NPS) impacts, and it is generally felt that biological monitoring is the best way to document such impacts. Chemical monitoring alone does not always reveal nonpoint pollution impairment.

Because the state itself is able to monitor only 41 stations on its 29,000 miles of streams, the SOS program provides an opportunity for citizens to fill in large gaps that currently exist in the data.

Initially, the West Virginia SOS program did not specifically focus on a particular stream or watershed. Instead, citizens were provided training at general workshops held throughout the state, then encouraged to adopt any stream of their choice, regardless of location or size.

The program has evolved a great deal since the early days, and the initial focus has changed. Instead of a generalized, random approach to stream monitoring, citizens are now trained to work in targeted priority watersheds across the state. The targeted watersheds are ones where nonpoint pollution impacts have been previously documented or are strongly suspected.

Training workshops are now held in close proximity to priority watersheds and citizens are encouraged to adopt monitoring stations on streams within the priority areas. The goal is to have volunteers adopt at least 20 stations within each targeted watershed and monitor them not less than quarterly, for a period of one year.

For each priority watershed, DNR provides to the Izaak Walton League a wish list of potential monitoring sites. The lists are provided to citizens at the training workshops and the volunteers are encouraged to adopt one or more of the recommended sites. In many cases, however, it is not practical for citizens to adopt sites that have been recommended. Site selection then becomes a compromise between what DNR would like to see monitored and what is practical for citizens to adopt. Once a network of stations is established, DNR personnel select a subset of the sites at random for supplemental chemical monitoring, which increases both the value and reliability of the program data.

Initially, DNR's major concern with citizen monitoring was the lack of adequate quality assurance. It was often difficult to determine whether the data being collected was valid. Today, an improved QA program has made the data generated much more reliable.

In addition to the regular training workshops, re-training (QA) workshops are held approximately six weeks after the initial training. At the re-training workshops, the monitoring skills of the volunteers are tested. Citizens are given a written exam which tests their ability to identify various groups of aquatic organisms and are taken into the field where their monitoring techniques are observed first hand. This approach enables SOS trainers to spot and correct problems the volunteers may be having with either the collection or identification of the organisms.

Perhaps the most important aspect of the quality assurance program is the oversight and coordination provided by local employees of the State Soil Conservation Committee (SSCC). SSCC technicians who are trained in the SOS program provide guidance and technical support to citizens working in the targeted watersheds. The technicians provide individual support in the field for volunteers who

might be having problems with monitoring techniques or data analysis.

Currently, 90 sites have been adopted statewide by volunteers, with the majority of the sites being located in five targeted priority watersheds. In the upcoming year, we hope to add three more priority watersheds to the program.

Ultimately, the DNR plans to use citizen-collected data to improve its understanding of NPS impacts in priority watersheds. It is also hoped that volunteer monitoring can help track the progress of Best Management Practices (BMPs) instituted in the watersheds to control runoff pollution. In addition, if volunteer-collected data is deemed of adequate quality, it may be included in the State Water Quality Assessment 305(b) report.

In conclusion, citizen concern for the environment is vital in making state water quality protection programs work. Often the important decision-makers, such as administrators and politicians, are more inclined to heed the advice of concerned citizens rather than recommendations from state personnel. In light of this fact, citizens should never underestimate their potential to effect positive environmental change.

LOCAL GOVERNMENT PARTNERSHIPS

*Panelists: Nancy Richardson Hansen, City of Bellevue, Bellevue, Washington, Storm and Surface Water Utility; Ray Tesh, State Water Control Board, Bridgewater Office, Virginia; and Terry Lee, Olmsted County Environmental Commission, Minnesota.**

Nancy Richardson Hansen

City of Bellevue, Washington

BELLEVUE'S STREAM TEAM PROGRAM

Local governments receive valuable assistance in fulfilling their water quality management mandate through the work of volunteers who can help in the following ways:

1. Volunteers help generate community support for the water quality and resource protection mission of your agency. By involving volunteers, you enlarge the circle of people who understand and support important resource management functions, which translates into long-term political and financial support.
2. Volunteers enhance efforts to educate the public about water quality and resource protection issues. Through interaction with their families, friends, schools and community groups, volunteers help spread the word and raise awareness about water resources and how to protect them.
3. Volunteers contribute to on-the-ground improvements in water quality and habitat protection. They can detect water quality problems, help revegetate or otherwise enhance fish habitat, prevent thoughtless actions such as pouring oil down a storm drain, and assist a resource management agency accomplish important tasks, such as monitoring, that might otherwise be left undone.

The city of Bellevue's Stream Team program was created in 1988 for all of these reasons. It involves citizens in monitoring and observing/recording the water quality and habitat value of our streams, which helps protect, preserve and enhance the stream environment. The Stream Team offers an annual series of public workshops as well as opportunities for children and adults to conduct hands-on monitoring activities. The workshops include topics such as water quality, aquatic insects, stream habitat, salmon lifecycle and habitat requirements, flood control, and wetlands and landscaping for healthy streams. Each workshop has a corresponding activity for interested volunteers.

Several written materials, including the Stream Team guidebook, newsletter and information on workshops and trainings, are regularly distributed to Bellevue citizens, businesses and the media. The Stream Team program also offers a variety of general volunteer activities such as storm drain stenciling, streamside revegetation projects and stream clean-ups.

Experience with the Stream Team program has taught city of Bellevue staff several valuable lessons about working with volunteers:

1. Plan to the last detail. Be very careful about going through the logistics beforehand to make sure everything will run smoothly for the volunteers. Develop checklists. Do a dry run. Prepare for contingencies. Bring extra supplies and equipment. It's also a good idea

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to plan for the maximum number of volunteers a project can handle so that every volunteer has something to do. For large projects, include volunteers in the planning process. This allows for some volunteers to assume a leadership role and alleviates some staff responsibilities.

2. Don't be overambitious. Design your activities, whether an indoor workshop or an outdoor project, with a definite start and finish. Design a project that will be doable and fun, not one that is burdensome and exhausting.
3. Show appreciation. Like all of us, volunteers need to feel their efforts are appreciated. There are many ways to accomplish this, from a well-planned event that anticipates their every need to a personalized thank-you note the week after the activity. Never forget to provide coffee and donuts!
4. Make the activity meaningful. Be sure to show the volunteers how or why the event is important. Make sure they understand how their efforts fit into the bigger picture. Involve volunteers in projects that are important, and give them plenty of feedback to let them know what has become of their labor.
5. Have something for everyone. Design enough variety into your program that you have activities to satisfy all levels of interest. Some people want to spend an entire day mucking in the mud while others may want to do something very limited and simple. A variety of activities will lead to greater volunteer involvement.
6. Be there for your volunteers. Make sure someone is available to work one-on-one with volunteers. If the activity requires prior training, make sure it is offered at convenient times (after work, for example). Again, personal contact and valuing each individual goes a long way toward keeping volunteers involved.
7. Listen to your volunteers. Volunteers know best what their needs are. They have extremely insightful comments on how to make activities run more smoothly and make them more meaningful.

More information on developing a Stream Team-type program can be found in the document, *Stream Teach Program Checklist: Involving Residents in Stream Protection*, which is available from the Stream Team Program, City of Bellevue, SSWU, P.O. Box 90012, Bellevue, WA 98009.

Ray Tesh

Bridgewater Valley Regional Office, Virginia State Water Control Board

VOLUNTEERS AND LOCAL GOVERNMENT

The value of volunteer environmental organizations to the Commonwealth of Virginia has not been assessed, although it is quite high and the untapped potential is even higher. In the Shenandoah Valley of Virginia, I work with:

1. Friends of the North Fork of the Shenandoah River;
2. Friends of the Shenandoah River;
3. Friends of the North River; and
4. Izaak Walton League of America (IWLA) Chapters in Front Royal, Winchester, Staunton and Harrisonburg.

These organizations assist their local communities by educating citizens, monitoring their respective geographical areas, and interacting with governing bodies. The degree of bonding to state government varies with each organization, as well as the methods for achieving the organization's goals. Each organization has communicated its goals to me in terms of the area in which they wish to make an impact, their agenda, and how we can work together.

I manage the pollution complaints program and supervise the response for my region. In this capacity, I function as an adviser to these environmental organizations, as well as addressing complaints over

which state law gives me authority. For the individual wanting to know who in state government to call about a specific problem, I can offer advice or refer them to the appropriate person. I believe public officials have a responsibility to assist individuals with real problems, to find a solution rather than pass the buck. Regrettably, there are still many pollution problems for which state and local agencies do not have defined programs and cannot satisfy the needs of the individual. We are, however, making progress. It is because of citizen groups and individuals speaking to their legislative representatives that increased authority and responsibility to address pollution problems is given to state and local government.

There are four methods to assist in achieving an environmental organization's goals:

1. water quality;
2. stream quality monitoring;
3. visual surveillance of the drainage area; and
4. review of industrial and domestic proposals which will impact the ground or surface water in some manner.

All of these methods are useful. It is up to the organization as to where to place the emphasis to solve each problem.

Two of our organizations have a substantial investment of time and money in water quality monitoring to establish a database which can detect trends in water quality degradation or improvement. All of our organizations are involved in stream quality monitoring which, for the most part, relies on the IWLA-initiated biological monitoring method. This program is important because it combines the effect of water quality with parameters frequently not monitored in the laboratory, such as siltation and erosion. Visual surveillance is also useful in that potential problems can be detected before extensive damage occurs.

In addition, citizen involvement in proposals for urban or industrial development inform decision-makers of an environmental organization's knowledge and opinions regarding specific actions. The local environmental organization knows more about a nearby stream than anyone else, and this knowledge must be shared.

Those of us in local and regional government are experiencing a time of tight budgets and certainly cannot accomplish the degree of monitoring and surveillance which we all desire. Now, more than ever, a partnership between active environmental groups and local government agencies is necessary.

Workshop Session I: Planning and Developing Successful Programs

GOAL SETTING AND ORGANIZING

*Presenters: Karen Firehock, Izaak Walton League of America's Save Our Streams Program; and Ken Cooke, Kentucky Water Watch.**

Karen Firehock

Izaak Walton League of America

STARTING A VOLUNTEER PROGRAM: IT'S EASIER THAN YOU THINK

There are many different reasons for deciding to begin a volunteer water monitoring program. The Izaak Walton League of America began its program, Save Our Streams (SOS), in the early 1970s as a way to educate and involve the public in the protection and restoration of rivers and streams. Since the 1970s, our biological stream monitoring techniques have undergone scientific revisions, and we have formed many partnerships with state governments so SOS data could be used by state agencies and volunteers alike.

When beginning a volunteer monitoring project the most important question to answer is: What are your goals? For instance, the SOS program has several equally important goals. The first is to educate the public about water quality through hands-on monitoring and to provide citizens with a way of revealing if a stream or river is polluted. We also try to give volunteers the knowledge to address pollution problems they discover.

The second goal is to help state governments expand their monitoring capabilities to survey rivers that might otherwise not get monitored and augment existing monitoring projects when the state has indicated more data are needed. This partnership approach, designed to serve both citizens and state agencies and enable them to help each other, has proved very successful in achieving maximum environmental benefits while minimizing costs. Be clear about what you hope to accomplish with your network and do not attempt to accomplish too much at once.

The following are some possible reasons you may be considering forming a volunteer monitoring network.

If you are a regional, state or local government:

- Educate the public on general water quality issues;
- Increase public involvement in state conservation programs;
- Increase the number of waterways you are able to monitor;
- Augment existing monitoring programs with more data;
- Activate citizens at the local level to address water pollution.

If you are an environmental organization or community group:

- Develop a way in which volunteers can readily detect water pollution;
- Help state and local governments monitor more waterways or obtain more thorough data on particular watersheds;
- Get your organization's members involved in hands-on protection of the environment;
- Increase community knowledge of water pollution causes and cures.

If you are a local business:

- Provide a way to get your employees involved in community service;

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- Demonstrate that your company is committed to environmental protection;
- Form a link between community needs and services your business can provide.

If you are a school:

- Provide students with a hands-on approach to learning about water quality and community stewardship;
- Assist local and state governments with their monitoring programs;
- Assure that future decision-makers and planners will have personal knowledge of water quality protection and restoration.

Once you have determined your goals, the next step is to choose a network structure and make it work. You will need to answer the following questions: Do you want to begin on a pilot basis and do a small-scale project so you can work the bugs out? Who will participate in your project (federal, state and/or local government or environmental organizations, schools or businesses)?

What type of monitoring will your group conduct, and what methods will you use to do this monitoring (chemical, biological, physical, habitat quality)?

How will you train your staff and/or volunteers to use these techniques? Will you train volunteers to train others, or will you train monitors directly? Will you periodically retrain monitors?

How will you build in a quality assurance/quality control (QA/QC) program as recommended by EPA so your data are assured to be scientifically valid? Who will accept, review and manage the collected data? Will the data be stored in files or on computer? How accessible will the data be, and who will need to access it? What feedback will be provided to the volunteers regarding the quality of their collected data? How can the data be reported to the public?

It is not always necessary to computerize your data if you are doing a small-scale project. It is also not necessary to have paid staff. Many successful volunteer monitoring programs, such as Friends of the North Fork of the Shenandoah River, are run entirely by volunteer coordinators. However, if you are a state agency, you should realize that a commitment by your agency to begin a volunteer monitoring program means increased time committed to the public, and a person should be designated to head the project. You should also make sure the position you create is discrete; do not simply assign one of your state water-quality staff to add these responsibilities to his or her already overloaded schedules or you will disappoint the public and lose their faith.

Your state agency may also want to form a partnership with an existing environmental organization. In West Virginia, for example, the Izaak Walton League runs the state volunteer monitoring program, which is funded half by the state and half by foundation monies. The state has a designated liaison who works with league staff, provides technical oversight and uses the data in state 305(b) reports, which are statewide river assessments.

Will your program include monitoring, identification of pollution problems and/or restoration of damaged ecosystems? How will you help volunteers deal with these issues? Will someone be available to answer volunteers' questions on a regular basis, such as a help line they can call or regular meetings to address concerns and questions?

How large will you allow your program to grow? For example, even though your project may be very popular, you may have to limit it to a certain number of stations, river miles, number of lakes or geographical range. If your program grows too large too quickly, you may end up not adequately serving existing monitors' needs, and you can become ineffective. You may want to develop a five-year plan after the first six months of the program so you know where you are headed. Share this information with others and plan for growth and funding.

Finally, how will you fund your project? While it may seem odd to ask this question last, it is better to have a clear idea of what you hope to accomplish before you seek funding. You should also develop at least three different funding scales for the project. Your first level should include a budget that allows you to run the program on a minimal but adequate

budget with no sacrifices in quality of data or assistance to monitors. This first budget may not include specialized publications, statewide conferences and the like, but it should cover the minimum needed to begin the project and run it for a year.

The second budget should include materials that would enhance your project, such as manuals on water quality issues, quarterly reports, press releases, new publications or workshops to address a variety of topics.

Your final budget (or third level) should include everything you need plus a wish list of things not critical to the project but which would enhance it. This budget might include big-ticket items such as statewide conferences, money to hire consultants for specialized trainings, teachers' training programs, additional staff or computer equipment.

Finally, it is important to remember that there is no exact prescription or model for a successful program. Each state has unique issues, concerns, political make-up, staff, funding and monitoring needs. The Izaak Walton League runs three statewide networks, all of which are organized somewhat differently to meet the unique needs of each state and the capability of the League. Although we organize projects in many other states, we use these three states to learn what works and what does not.

The League created the *Citizen Monitoring Bibliography,* a list of useful publications, equipment and materials about how to start an effective volunteer monitoring program. To recieve a copy of the bibliography, write to: Save Our Streams Program, Izaak Walton League of America, 1401 Wilson Blvd., Level B, Arlington, Va. 22209.

REASSESSING AND EXPANDING CURRENT PROJECTS

Susan Handley

U.S. Environmental Protection Agency, Region 10

Kathy Ellett

Alliance for the Chesapeake Bay

Mary Francoise Walk

Massachusetts Acid Rain Monitoring Project

HOW TO BREATHE NEW LIFE INTO EXISTING PROGRAMS

In reassessing any volunteer-based program, it is vital to take a close look from the perspective of your volunteers at how the program is designed and implemented. An error made by most program managers is that they design and implement programs to meet their needs, not those of the volunteers. This is the major cause of program problems and failures.

We have experienced a related problem in the Chesapeake Bay Citizens Monitoring Program (CBCMP). The data collected by the volunteers is only a small part of a very large monitoring effort. Consequently, the analysis and reporting of these data is never a high priority, and it has been difficult to get anything other than simple listings and plots produced. Many managers feel that a report that does not contain results based on sophisticated analyses is a waste of time and paper. However, seeing their data in print, even with a limited interpretation based on comparisons of data collected in previous years, is the single most important motivator for volunteer monitors.

A typical example is the clash of interest between scientists managing a project and the volunteer monitors. At the beginning of a project, the scientists want to establish a baseline of data from which they can infer, over time, existing problems and the direction the monitoring will follow next. Volunteers, on the other hand, want sexy data right away; for instance, data that can be used to unveil a suspected pollution source that they want to fix immediately. If the project manager disregards this need, volunteer monitors lose interest rapidly and leave the project.

For instance, the Massachusetts Acid Rain Monitoring Project (ARM) recently lost some volunteers who thought that acid rain is no longer a problem. If we had known that was their perception, we could have nipped that notion in the bud (by writing a piece in the newsletter on the current status of acid rain and research needs).

How then do you gain your volunteers' perspective and keep them interested? One way is to try to decipher what motivates a person to volunteer and stay with your program. There has been a tremendous amount of research and study done on human motivation. For our purposes today, we will look at the studies done by David McClelland on work-related behaviors.

McClelland divides motivation into three major types: achievement, affiliation and power. Those who are achievement motivated tend to be task oriented and need to be successful. Their strengths are that they get the job done and are willing to overcome obstacles. Their weakness is they would rather do new, different and challenging tasks and work on their own. People in this group are good at gathering information, systematizing, developing procedures and evaluating results.

Those who are affiliation motivated need to work with others and feel that they are a well-liked and important part of the team. The strength of this group is that they have excellent interpersonal skills and work well with others. The weakness of this group is that they are easily hurt, can't say no and avoid any conflict. They don't always get the task done. These are the people to promote compromise, relieve tension and encourage others.

Those who are power motivated need to be in positions of status where they can influence others. Their strength is that they are confident, articulate and willing to take risks. Their weakness is that they can appear to be domineering, impatient and sometimes arrogant. These are the people who initiate programs and activities, and press for results.

We're not recommending that managers sit in their offices and guess what motivates their volunteers, but rather that they take time to talk to their volunteers. Interviewing volunteers is critical for many reasons: placement, training, evaluation and understanding their perspective on their role in your program. Even for experienced managers, practicing interviewing skills is always beneficial.

Another element in reassessing your program from the volunteer's perspective is to have an understanding of what is referred to as the Volunteer Life Cycle. This concept has been presented by Sue Vineyard and has value for all managers. Its basis is that most volunteers go through a predictable life cycle in their volunteering experience. Managers need to look at why the volunteer joined the program. Have those needs been met? Remember, a met need is no longer a motivating force. What other and different needs does the volunteer have which can be met by the program? Go back to your understanding of motivation. Is the volunteer in need of more social opportunities (affiliation)? Is it time to give the volunteer some responsibilities (achievement)? Is the volunteer in a position to train or lead others (influence)? Are there opportunities for volunteers to help with program evaluation and redesign? One of the most effective tools in determining what to do at these junctures is to convene a volunteer steering committee to bring the volunteer perspective to program design and management. Another way is to send out a questionnaire or, if time permits, conduct phone surveys.

Other questions managers should ask themselves include: Are all volunteers leaving at the same spot in the cycle? Are all volunteers, regardless of where they are in the cycle, treated the same? Is there opportunity for volunteers to share and lead? For instance, ARM and CBCMP volunteers leave either very shortly after they started volunteering (within a year) or after a long time with us (more like seven years).

Often managers provide volunteers with recognition that is not meaningful or significant to the volunteer. A re-examination of recognition activities, taking into account the volunteer's perspective, will make recognition more meaningful and cost-effective. In the 1980s, Ardis Young from Washington State University did a study on volunteer recognition using 4-H leaders. The overall conclusion of the study was that volunteer rewards and recognition should be intrinsic to the job itself. People do not volunteer for pins or plaques, and most appreciate recognition that is personalized. Recognizing a group as a whole is much less meaningful than recognizing individuals for their unique contribution. In the Young study, the first response to what volunteers felt was most rewarding about their work was that the volunteer reached a personal goal; the second response was that they were accepted as a person; and the third response was that others asked the volunteer for his/her opinion. As you can see, recognition need not be expensive or complicated.

Some good techniques are to ask a volunteer's advice, write a personal thank-you note or design methods to let family or peers know of the volunteer's accomplishments. Examples of other types of recognition include writing a volunteer's job supervisor, praising the volunteer's commitment and precise work. This is sometimes taken into account when the volunteer is up for a promotion in his/her profession (we did this for a college professor who is a laboratory analyst volunteer in ARM).

ARM also wrote an article about the project, personalized to each region, at the request of volun-

teers who submitted the article with a photograph to their local newspapers. Several newspaper reporters and a couple of TV stations have interviewed volunteers and published stories about CBCMP. We found that the best reward is to share results promptly and to demonstrate how they are used. A visit to the volunteers with a slide show sounds like a good idea, although we don't always get good attendance. CBCMP also has speakers, tours and pot luck suppers at quality control sessions. ARM has printed tee-shirts, buttons, stickers and certificates of appreciation. All have been favorably received and give the volunteers a sense of belonging to the group, which can be lacking in projects spread throughout a state or region.

CBCMP volunteers receive a thank-you gift each year. Past gifts include ornaments, organizer folders, posters, matted prints and plaques. This year ARM didn't have the money to give out tee-shirts, so we printed a calendar, which serves two purposes: A thank-you gesture to our volunteers, and (if they use it) a reminder of the collection dates, which are printed directly on the appropriate days on the calendar. Forgetfulness about sampling dates is a common problem for us.

Program expansion can be a natural outgrowth of the reassessment process, but it should be based on matching volunteers' needs and interests with program objectives. Expansion can provide additional opportunities that are needed at critical points in the volunteer's life cycle.

A program review is a good idea when you have accomplished something. If you have gathered the data you needed, are you using it? If your ultimate goal is to clean up your state's lakes, have you turned your results into legislation or on a smaller scale, into bylaws? If your goal is to preserve a specific river, are you using your data toward a designation to preserve the status quo?

It may be time for remedial action. For instance, finding bacteria in streams running through grazing ranges could prompt you to work with Trout Unlimited on a fencing project to keep the cattle out of the streams. If you have confirmed a problem, say fecal coliforms in your water body, have you found the pollution source? If not, isn't it time to expand the project and increase the monitoring to more sites or even to the whole watershed?

Review your program regularly. Is there slippage in volunteer commitment? Are new methods available? Is your QA/QC program working? Is there a better way to conduct your project? Get your volunteers' point of view.

If all is well, move to forestall boredom. For example, the Massachusetts Water Watch Partnership has various monitoring modules; they start simple and tailor the monitoring to each local group. When the volunteers have mastered a basic module (monitoring for temperature, pH, alkalinity and dissolved oxygen), they can move on to a more advanced module (phosphorus, chlorophyll, heavy metal, organics) or they can add a different module, such as biological monitoring.

ARM periodically does side studies, which add interest to the otherwise monotonous routine of quarterly sampling. A couple of times we asked volunteers to measure stream temperature and characterize stream substrate for a Fisheries and Wildlife study on stream candidates for trout stocking. Currently, we have a few volunteers read U.S. Geologial Survey gages to help us in our analyses. If we provide the equipment and good instructions, volunteers are happy to do it. We haven't asked for stream temperature in two years, but some volunteers are still reporting it quarterly!

Also, encourage individual associations to use their data themselves and build a larger context around the monitoring, such as setting up a museum exhibit about their river to tell the community about it.

PROCEDURES FOR COLLECTING QUALITY DATA

Linda Green

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DEVELOPING A QUALITY CONTROL/ QUALITY ASSURANCE PLAN

Collecting believable water-quality data and verifying its validity has always been a challenge to the professional or the layperson. One of the strengths of citizen monitoring groups is that they often have many willing and enthusiastic volunteers, whereas government agencies at all levels are often limited by staff and finances. Although policy makers and regulators welcome volunteers' enthusiasm, time and energy, they are often initially skeptical of whether volunteers can provide meaningful data, as well as proof of its value. One of the biggest questions confronting users of any sort of data is how accurate and precise is it? How many measurements were made in order to reach this number? How variable is the measurement? How accurately does it reflect the actual situation?

These questions can be addressed by the formulation of a Quality Assurance/Quality Control (QA/QC) plan. In this paper we will discuss setting up and using QA/QC plans, particularly in terms of the most common measurements (parameters) used by many volunteer water quality monitoring groups. The approach will be as non-statistical as possible and is directed toward volunteer monitors, especially those involved in ecological monitoring. Readers are directed to EPA's guidance document, *Volunteer Water Monitoring: A Guide for State Managers* (1990).

The purpose of a quality assurance program is to ensure that data meet desired levels of accuracy and precision. This includes both quality control and quality assessment activities. To assure accuracy, one needs to evaluate and control the quality and reliability of data collected and tests run. This is known as quality control. Some standard quality control activities are:

1. Use methods that have been well studied and accepted by experts in the field;
2. Routinely analyze samples of known composition and concentration (internal standards), so that you know what and how much you are analyzing and if your procedure is consistent from one date to the next;
3. Confirm your monitoring group's (or laboratory's) ability to provide acceptable results by analyzing reference samples (external standards). This is an excellent process especially if your procedures are different from established ones;
4. Incorporate field and analytical blanks into your procedures. Unexpected sources of contamination can often be detected, as well as background contributions to what you are measuring.

Quality assessment involves continued evaluation of people collecting and analyzing data in order to minimize/correct individual errors and their cumulative effect.

There are five terms that are used to assess quality known as Data Quality Indicators (DQI). They are accuracy, precision, representativeness, comparability and completeness. Some of them have precise statistical definitions as well as conceptual meanings:

ACCURACY

Accuracy is determined by analyzing a sample of known concentration and comparing the results to the "true value." Accuracy is also known by the terms bias or relative error. It is a measurement of variation in data that can be due to either the equipment used or the procedure. (This is known as a systematic error.) Accuracy is computed statistically by the following equation: 100 X (true value - actual value) /true value.

What happens if you don't know what the true value is? This can be the case in a number of situations such as using a secchi disk to measure water clarity or using a kit to measure a parameter without confirming it using a different method. The most practical solution is to make a number of measurements, average them, and state that no estimation of the accuracy can be made. However, if volunteers are using a test kit, for example, to measure dissolved oxygen or pH, there are a number of alternatives. If the data using the kits is to be believed and accepted, it would be a wise investment to purchase or borrow an analytical or laboratory grade meter to compare results against initially and during QC sessions. An alternative would be to see if a local analytical or university laboratory might agree to compare the results from your kits with their equipment. If the measurement is to detect a trend, using the kit alone might be sufficient. The choice depends on your data quality objectives.

PRECISION

Precision is a measurement of how close data points are to each other. Measuring precision gives no information about the accuracy or closeness to the true value of the measurement. Other terms for precision are repeatability or replicability. They all refer to the measurement of random variation in data.

Precision is measured statistically by calculating the standard deviation. Many hand-held calculators have been pre-programmed to calculate the standard deviation, usually denoted by s or sx. The standard deviation is an indication of the range of variation in the measurement. Even more useful is the calculation of the coefficient of variation, which is simply the standard deviation divided by the average of the data, multiplied by 100. A large coefficient of variation means that the measurement is less precise, a small one that is more precise.

As an example, suppose your group is interested in their precision in determining the clarity of a body of water. Ten volunteers, assigned letters A through J, have each taken one measurement at the same location. Their measurements are tabulated below, along with the standard deviation and coefficient of variation. Overall, these data would be reported as 5.0m, standard deviation = 0.38m. The 7.7 percent coefficient of variation indicates that the variation in the data is about 8 percent of the average. This is also an indication of the variation in the data that might be expected from the group as a whole.

Volunteer	Secchi Depth (m)	Volunteer	Secchi Depth (m)
A	5.1	F	5.1
B	5.2	G	5.4
C	4.8	H	4.8
D	4.1	I	4.8
E	5.3	J	5.3

Average = 5.0m
Standard Deviation = 0.38m
Coefficient of Variation = 7.7%

REPRESENTATIVENESS

Representativeness attempts to answer the question of whether the data accurately and precisely represent the actual environmental conditions. This is not easily answered because errors can be introduced in any number of places, from choice of monitoring location to sampling containers to sample holding to lab errors to data entry errors to calculation errors. It is important that there are clear instructions for where, when and how many samples to collect, what to collect in them, and how they are to be treated once they have been collected. In general, as the number of samples increase, the amount of bias or inaccuracy decreases.

A sample may become unrepresentative by virtue of the choice of sampling locations, also known as

the sampling design or sampling scheme. There are three general types of sampling schemes: judgmental, systematic and random. Judgmental sampling indicates that you may be drawing a conclusion where you are monitoring: This is the least statistically valid scheme and usually the least expensive. Systematic sampling involves making a measurement at certain intervals which may be in space or in time, such as sampling every other Saturday. Random sampling is the statistically best choice and may be required; it also usually costs the most. There are a number of different combinations of these three schemes which will not be discussed here.

Sampling devices can introduce errors by either adding to the amount of a sample or even subtracting from it. For example, if you are interested in measuring the dissolved oxygen content of a body of water, you should not use a pump to collect the water, since the turbulence of the pumping can introduce air into the water. If you are collecting a water sample to measure petroleum hydrocarbons, do not use a pump with greased fittings. Sample contamination may become efficient after analysis of field blanks. This involves bringing a container of distilled water to the field, rinsing the sampling apparatus with it, collecting this water in the usual sample containers and processing it identically with the rest of your samples. Remember, the possibility of contamination increases as the concentration of the parameter decreases. It is much easier to contaminate something being measured at the part per billion level than at the part per million level!

Choice of sample container and how it is cleaned can be crucial. Texts such as the American Public Health Association's *Standard Methods for the Examination of Water and Wastewater* detail the preferred container, depending on the type of analysis. Several suggestions in terms of container preparation include not washing with phosphate detergents if you plan to measure phosphorus, not using containers rinsed with nitric acid (used to prepare containers for metals analysis) for the measurement of nitrates in water. Acid-washed glassware that has not been allowed to equilibrate in distilled water may absorb metals or salts out of solution, decreasing their apparent concentration.

Sample handling and transport can be equally critical. Certain analyses, such as pH and bacterial indicators, must be initiated within hours after sampling. Samples for other analyses may be stored for up to a month. Water samples generally should be kept cool and in the dark to prevent acceleration of chemical reactions or degradation of biologically sensitive materials. If you plan to measure water temperature, do it before you put your water sample in the cooler.

COMPLETENESS

Completeness is the percentage of valid data obtained as compared to that expected to be obtained under normal conditions. Sampling sites may be inaccessible at certain times of the year; there may be equipment failure or breakage, or samples may be spilled during collection, handling, transport or analysis. Depending on the group's data quality objectives, it can be acceptable, for example, to expect to receive 80 to 90 percent of secchi depth and water temperature data, since sampling dates may be missed due to illness, vacations or even hurricanes! The situations where you most likely expect to lose data should be pointed out, with remedies specified.

COMPARABILITY

Comparability is a measure of the confidence with which one group's measurements can be compared to another. How well do the data from one monitoring program compare with another? Types of comparison can include:

1. Locations of sampling sites (if all lake sampling stations are located over the lake's deep spot, each program has the same probability of collecting a representative sample);
2. Parameters measured (secchi, temperature, nutrients) as well as units of measurements used;
3. Procedures and methods for sample collection and analysis; and
4. How data can be compared (statistically) among programs in terms of precision and accuracy.

Simply stated, a quality assurance project plan (QAPjP) documents the thought process that goes into planning, carrying out and reviewing a specific data collection activity. The discipline of developing QAPjP forces study organizers to develop a rationale for their data collection to document it. The plan conveys direction serving as a map for your data collection activity. It can serve as a training tool for new participants and with regular updates, it provides an historical record of the project design over time. One configuration of a QAPjP commonly utilized in Environmental Protection Agency-related plans is drawn from the agency project plan guidance known as QAMS 005/80. This QAPjP plan with its 16 elements takes the project planner through a series of descriptions and decisions which, when complete, should substantiate the design of the monitoring program. This plan should be considered a dynamic and living document which is routinely reviewed and modified to reflect the current operation of the monitoring program. Changes should be dated and a record should be maintained which includes the dates of all changes so that potential effects upon the data can be evaluated. The 16 elements of a QAPjP should include:

1. Title page;
2. Table of contents;
3. Project description;
4. Project organization and responsibilities;
5. QA objectives for measurement data, in terms of precision, accuracy, completeness, comparability and representativeness;
6. Sampling procedures;
7. Sample custody;
8. Calibration procedures and references;
9. Analytical procedures;
10. Data analysis, validation and reporting;
11. Internal QC checks;
12. Performance and systems audits;
13. Preventative maintenance procedures and schedules;
14. Specific procedures to be used to routinely assess data precision, accuracy, comparability and representativeness of specific measurement parameters involved;
15. Corrective action;
16. QA reports to the data requestor.

There is nothing magical or rigid about these elements. However, this 16 element approach or another like it represents an investment in the proper design for a monitoring program which is likely to meet the needs of the project for data of a specified quality. Keep in mind, if you don't have time to do it *right,* when will you have time to do it *over?*

For a QA/QC program to be successful, it must become an integral part of a monitoring program. Volunteers must be made aware of the need for ongoing QA/QC checks, and not feel threatened by the thought of being tested. When volunteers are first trained, QC tests can be conducted to get an idea of the initial accuracy and precision that may be expected. A subsequent QC session should be held about one-third of the way through the monitoring season to check on the monitors' techniques and answer questions. Two QC sessions per monitoring season are generally sufficient. All volunteers should attend these sessions, which provide an opportunity to socialize as well as remind monitors that they are part of a team. At the sessions, it is preferable to have monitors use their own kits to test the same water samples, since this is a more realistic portrayal of their actual monitoring.

An alternative QC check is to have the volunteer coordinator visit each monitoring location with the volunteer to monitor the water body simultaneously and to observe his/her monitoring technique. A return visit, without the monitor, at approximately the usual monitoring time and date can be made as an additional check. This is generally more time-consuming, but may be necessary to validate volunteer-collected data.

DECIDING DATA OBJECTIVES

Presenters: George Norris, North Carolina Stream Watch; Mary Kelly, Western North Carolina Alliance; and Jeff Schloss, New Hampshire Lakes Lay Monitoring Program.

George Norris

North Carolina Stream Watch

MEETING YOUR GOALS WITH DATA COLLECTION

What do you want to know and why do you want to know it? In an attempt to be as rational as possible, it is a good idea to look at data collection in comparison with the goals of your program. In North Carolina's Stream Watch program, our primary goal is education. This leads to our secondary goal of taking personal action based on knowledge of water quality. Personal action might include: reporting unusual conditions or discharges to the Division of Environmental Management (North Carolina's regulatory agency for water quality); organizing cleanups; or becoming active in local zoning decisions.

The Stream Watch program has always sought to be all-inclusive and decentralized. As a result, our program goals are very broad and perhaps fuzzy. Each Stream Watch group may have different goals and undertake different activities. We have very few restrictions beyond illegal actions. In my experience, this diversity has made clearly stated objectives for volunteer monitoring more difficult to develop.

North Carolina Stream Watch includes conservation groups, girl and boy scouts, neighborhood groups, 4-H'ers, Trout Unlimited chapters, various canoe clubs and school groups. More than one quarter of our groups are school related. Very few of these groups can afford to participate in a chemical monitoring effort.

Money is the dominant issue for North Carolina's chemical monitoring network. Out of 190 groups that have adopted streams, only 16 routinely participate in chemical monitoring. The reason is simple: The Stream Watch program is unable to assist groups with the cost of acquiring chemical test kits. Most groups that participate in chemical monitoring are associated with an existing conservation group which has many members who pay dues; therefore these groups have more people, a greater sense of direction and purpose, and of course, financial resources.

In addition, many of these groups are based in urban areas where streams are not always in the best shape. The results of biological monitoring alone are often not that useful on a stream degraded by channeling, urban runoff, peak flow scouring or vegetation removal. In such instances, biological monitoring will indicate poor water quality (big surprise) and reinforce evidence of a problem. However, the problems in urban streams are so pervasive that chemical monitoring is often needed to identify sources of pollution.

Given the nature of the groups doing the testing, what tests should be run? All tests and information are important. The key is to prioritize tests based on your environment, group interests and cost, and what information matters most. In North Carolina, we have chosen to run tests for pH, nitrate, phosphate and dissolved oxygen.

The test for pH is run because a wide fluctuation in pH often indicates a cataclysmic event, such as a chemical spill. This is particularly relevant in urban and suburban streams with numerous road crossings

and opportunities for spills. However, there is the drawback of monitoring once per month and missing the spill that occurred last week. Finally, pH has obvious implications for aquatic life and is inexpensive and easy to perform.

Dissolved Oxygen (DO) is another test that over time gives important information on stream health and has an obvious impact on aquatic life. When monitoring DO, it is always important to remember the influence of temperature, time of day, and seasonal variation. DO readings are crucial for deciding whether or not new sources of effluent are allowed and can alert Stream Watchers and the state to the possibility of fish kills. Low DO readings can also indicate sewage leaks, which is especially important in urban areas where extensive sewer systems include sewer lines along stream banks.

Our chemical testing network also measures phosphate and nitrate levels in given streams. These tests are valuable because nonpoint source pollution is difficult to get a handle on. Also, large rivers in the coastal plain are plagued by algal blooms in the summer, and a large part of the problem arises from nutrient loading occurring in the Piedmont. Nutrient loading is not only a rural, agricultural issue, but also an urban and suburban one.

Stream Watch monitors perform biological assessments as well as chemical tests. As mentioned, some of these streams have very few species of macroinvertebrates, but biological monitoring is much less expensive and lends a living element to monitoring. It also gives a much broader view of a stream's health and works well in combination with chemical monitoring. Many things can be wrong with a stream that the four chemical tests will not detect, but a biological test can give you an overall statement of a stream's health.

There is another type of monitoring which I call monitoring the obvious or simply noting the stream's environment. Does the substrate consist of sand, silt or gravel? Does the stream have a closed canopy? What is the water temperature? Has it rained recently? Is the stream flow high, low or average? Does the stream appear to have a sediment problem? Answers to these basic questions serve as a context in which to read the chemical and biological tests, and this information should always be included in a reporting format.

Coliform testing is another area in which volunteers have expressed interest. There are inexpensive tests that let you know if coliform is present, but these do not really tell you much about the stream, except to flag possible sewer line breaks or areas where animal waste loads are heavy. Unfortunately, most quantitative coliform tests involve heated water baths which make them too expensive to be practical for most groups.

There are other valuable water tests, which the Stream Watch volunteers do not perform. Heavy metal tests could be helpful for many urban streams. Groups monitoring trout streams in the mountains would value knowing the alkalinity or the buffering capacity of their streams. Salinity is crucial in estuaries, but not important in freshwater areas.

When you prioritize data needs, consider the streams being monitored and what information is important for the health of those waterways. Volunteers want to make a difference, and it is up to us to determine what data and applications will work best.

To determine what matters, consider how the data will be used. Primarily, the data should inform us that something is amiss and provide clues as to the cause of the problem. Data collection should let the monitor know the condition of the stream and whether it is deteriorating, improving or not changing at all.

When a monitor encounters a problem on the stream, it is much more helpful to report a dramatic drop in pH or some other quantitative result, rather than to merely say the stream smells funny. One of our monitors was able to pinpoint a chemical spill resulting in a fine for the culprit. Informed monitors with knowledge of water quality get better results with regulatory agencies.

With all this testing, volunteers are generating an immense amount of data. If it just sits around in some obscure databank or in a report on a dusty shelf, the volunteer will lose interest. Our challenge is to make volunteer-collected data useful to our regulatory agencies. Most streams in North Carolina are monitored

once a year by the Division of Environmental Management (DEM). Our volunteers monitor twelve times a year, so obviously we have more thorough information on our monitored streams. We must present the data to the DEM and win their confidence concerning the quality of citizen monitoring efforts.

Towards this end, the Stream Watch program generates a report incorporating all data into a graph format that indicates data-collection consistency as well as demonstrates any fluctuations in water quality parameters.

Mary Sauls Kelly

Western North Carolina Alliance

written with William McLarney, consulting biologist

PLANNING AVOIDS PITFALLS

The principles for planning a volunteer monitoring project and the types of data that will be collected are very similar to planning any scientific research project. In my portion of this workshop, I hope to share some of my own experiences and training as a scientist, researcher and teacher with the Western North Carolina Alliance.

Successful scientists know that it is extremely important to put as much thought and effort as possible to planning for any research project, especially in determining the data objectives. Such planning can literally save years of expensive, time-consuming data collection efforts from turning into an unmanageable mess and/or a disappointing waste of time. Successful volunteer monitoring projects are like scientific research in that:

1. They must be designed to make sense of the tremendous variation within natural and human-disturbed systems;
2. They must be able to produce consistent, manageable data sets;
3. They should be tailored to suit the particular needs of those who will be using the data to make future decisions.

All this merits careful planning and regular assessment. There are a large number of physical, biological and chemical parameters that relate to the quality of water and aquatic habitats, and the structure and function of aquatic ecosystems. Data could be collected on any one or all of the different parameters. The types of data you decide to collect should depend on your group's overall purposes, interests and the specific types of human-induced alterations that are of concern. The data you collect should address the questions you hope to answer, and you can expect to accumulate lots of data. To be useful, this data must be collected using consistent methods.

Often, the most important objectives of volunteer monitoring projects are the education, involvement and motivation of volunteers. Although the types of data collected for monitoring purposes may not need to be as rigorous or carefully designed as those needed to scientifically test hypotheses, the same basic principles can be used to avoid the same types of pitfalls. No one wants to spend a lot of time collecting data that turns out to be less than useful, especially if a little planning ahead of time could have avoided the problem.

When working with a variety of volunteers with different skill levels, who are scattered across multiple watersheds, it is crucial that the types of data you collect and your methods of data collection are replicable. In a volunteer-based project, the types of data you can collect in a replicable, consistent manner may be limited unless you can invest a lot of time in training volunteers. In terms of statistical analysis and making decisions with your data, it is usually more important for your volunteers to be able to gather multiple replications of consistent quality than it is to have a small number of highly precise or accurate measurements. Gathering enough consistent data is the only way to be able to make useful, valid comparisons between sites, watersheds and years.

Any scientific research or monitoring data collection effort must address the inherent variation in measured parameters for both disturbed as well as natural aquatic systems. Factors such as water tem-

peratures, stream flow rates, chemical concentrations, densities and organism behaviors are naturally going to be variable. In addition to natural variables, your group will want to determine when and where man-made peaks or sources of pollution, disturbance or alterations to biotic communities occurred. The principles of statistics and sampling theory are an attempt to allow one to sort out whether the differences noted in physical, chemical or biological parameters are within the normal or natural range or whether they can be attributed to some unusual event, man-made causes or progressive trends over time.

When thinking about the kinds of data you want, also keep in mind who you hope to influence with your data. Most groups don't collect data just for their own members. Useful data augments the efforts of local, state or federal regulatory or monitoring agencies. One of your data objectives should be to produce a data set that measures the same or similar parameters (chemicals, DO, species) and that will be of acceptable, consistent quality and useful to the agency you want to influence. In our case, the Tennessee Valley Authority (TVA) was already committed to using biological monitoring and an IBI approach for fish. However, we are still trying to decide which of several macroinvertebrate sampling techniques will provide us with the most useful information.

We collect data which quantifies existing problems due to poorly constructed roads, parking lots and other urban runoff problems. WNCA also made an effort to collect data on brook trout populations when we learned that the state fish and wildlife agency had an initiative to urge North Carolina's Commission to upgrade any stream with brook trout populations to a more protective classification.

WNCA decided to collect data on shoreline recreational opportunities (potential boat access points) because of interest from members and others in the community and because there was an initiative to identify possible greenways. Likewise, it proved very useful to record observations on areas where unfenced pastures were allowing cattle to erode streambanks. This information, along with the landowners name, was given to the local office of the Soil Conservation Service, which was looking for farmers who would benefit from participating in a new state cost-sharing program for streamside fencing.

Sometimes we find ourselves collecting data because no one else is doing it, and we hope through our homegrown efforts to force additional funding or programs. This can be an extremely important data objective in cases where a group feels that an agency is not collecting adequate monitoring data because they (and you) know that monitoring would likely cause them to have to shut down or modify pollution sources. In this case the overall quality or consistency of your data may be less important than being able to obtain samples which address the problem. For example, a series of carefully documented daily photographs of an ugly, ongoing oil slick, when waved in front of the press, local government or agency officials may be a far more effective data set than an expensive, one-time chemical analysis.

If you are planning a water monitoring project and are not experienced in principles of statistics, experimental design and aquatic science, seek the assistance of water quality experts, aquatic ecologists, regulatory agencies and others. Even if you feel you or someone in your group has expertise and your data collection plans are basically good, it never hurts to consult with others doing similar work. Scientists call this peer review, and it is considered a vital and necessary part of developing and revising a research proposal. Consider it friendly criticism that can save you years of work, help you coordinate your efforts with those doing similar work, and help you avoid mistakes that others have learned the hard way.

Some volunteer monitoring networks may be fortunate enough to be able to collect state-of-the-art, high quality data suitable for making some serious decisions (such as regulatory enforcement). But more often, volunteer monitoring works best as a flagging technique, to identify and bring needed attention to problem areas. In most cases, government agencies will have to be brought in to replicate

or confirm volunteer network findings. But volunteer networks and the data they collect can play a vital role in helping to gauge priorities and keep the pressure on for cleaner streams, rivers and lakes. For these reasons, volunteer network planners should think long and hard about the tradeoffs between trying to collect top-notch data versus being able to collect poorer quality data, but using a larger number of sites and volunteers.

As part of this workshop, we were asked to discuss the pros and cons of biological and chemical monitoring. I have to admit that when it comes to monitoring stream and river ecosystems, we are strongly biased towards biological monitoring. First, our project was envisioned and implemented by an aquatic biologist. Chemists may feel differently, but biomonitoring tends to be much more fun to carry out. It's the basic differences between collecting a netful of diverse, squirming, living critters versus a sample bottle full of water. Most lay people find the results of biomonitoring to be more meaningful, intuitive and inspiring. Another advantage (especially if you can find some low-cost biologists to identify samples) is that biomonitoring tends to be less expensive. After an initial out-lay for basic collection equipment such as nets, buckets and electro-shockers (for fish), data collection and analysis expenses can be minimal. One possible disadvantage (but this applies to chemical data as well) is that it usually requires at least one biologist to make sense of your data.

Many aquatic ecologists are increasingly recognizing that the presence/absence and relative abundance of different groups of organisms can be a far more sensitive and integrative indicator of water quality than chemical monitoring. This is the basic principle behind methods such as Index of Biological Integrity (IBI), which we used in our studies. Biomonitoring enables us to gauge the overall health of a stream over a relatively long period of time. It has become fairly well established that different groups of organisms have different levels of sensitivity to pollutants, temperature changes, sedimentation, etc. Also, many organisms have life cycles of one to several years. Therefore, the presence, absence or abundance of different groups not only indicates what the current water and habitat quality is like, but also whether there were any problems in the past. A healthy, diverse collection of aquatic fish and insects at a site indicates that water quality must have been reasonably good at that site for at least as long as it took those organisms to be born and live to their current ages.

Contrast this with a sample of water chemistry: you may or may not catch the offending pollutant in your sample. If you sample on Monday, the slug of pollution that was released on Sunday is likely to be long gone, washed downstream. Biological communities are affected by all factors that affect habitat quality, and this does not allow for determining one aspect of water chemistry. Chemical monitoring, however, is very useful as follow-up.

Jeffrey Schloss

New Hampshire Lakes Lay Monitoring Program

SELECTING OBJECTIVES FOR A SUCCESSFUL PROGRAM

So, you have an eager group ready to go out and start sampling. Before you grab your equipment and head out the door, make certain you've taken the time to consider what you want to accomplish.

What are the appropriate procedures needed? Are the necessary resources available? Will the sampling frequency allow you to attain the level of information about your study area adequate to meet your participants expectations and the data users' needs? These are just some of the many considerations involved in developing a successful monitoring program.

There are many model citizen monitoring programs to emulate as well as many proven techniques and protocols for volunteer assessment. However, unless your monitoring program is meeting the decided objectives of your participants and cooperators, the program will not attain its true potential.

Careful consideration must be given to the who, what, why and hows of volunteer monitoring to be successful. In this paper, I will take a general approach to deciding data objectives based on my experience coordinating a long-term volunteer lake monitoring program and assisting in the development of estuary, river and stream monitoring programs.

The process should start with a meeting of the potential cooperators: volunteers, educators, agency personnel and decision-makers. While certain groups may not have direct participation in the program, if they will use the data they should be queried on their needs. You will not be able to satisfy everyone — no program will — but you will have a greater insight into potential goals you may set for your program.

DETERMINING YOUR PROCEDURES

With your goals clearly defined, it is now time to determine the procedures that will best meet your objectives. Important considerations for volunteer program methods include safety, cost and complexity. The challenge to volunteer monitoring programs is to develop cost-effective field sampling procedures that will produce acceptable and informative data. More specific questions often need to be asked dependent upon your particular scenario.

If you will be working with historical records, are the procedures chosen consistent with the historical data or convertible for comparison? If you want your data to be used by resource agencies, does it meet their requirements? In this case, the same procedures do not necessarily need to be used if you can show that your procedures are comparable or convertible, and you utilize adequate quality control/quality assurance. On the other hand, your procedures do not need to be as rigorous if your objective is to perform a screening or preliminary assessment from which your local or state agencies will follow up with more intensive sampling.

Would it be beneficial to use the same protocols as other nearby or regional volunteer programs, or do your specific needs and situation warrant different procedures? Take all the particulars into account and be sure the procedures you choose match your program goals, available funding, available expertise (for guidance, assistance and training), and the regional character of the natural resource you monitor.

Testing procedures can generally be broken down into four categories: physical, chemical, biological and observational. Generally, programs use a combination of procedures that complement each other.

Physical sampling methods tend to be inexpensive and are generally less complex. Some physical measurements are frequently overlooked as they may only provide supplementary information, but this information may be very important to a group of data users. For example, the temperature monitored throughout an estuary on a timely basis may assist researchers in their understanding of the migration patterns of important fish species. Temperature changes in a stream documented after forest clearing can illustrate the importance of shade cover. Many lake programs use temperature profiles to determine the depths that water samples will be drawn from. Lake, pond, river, stream and estuary programs often require temperature data in conjunction with oxygen measurements to obtain information on the level of oxygen saturation of the waters. This parameter is much more informative than dissolved oxygen levels alone.

Chemical methods have been the most popular in the past for many reasons. Most regulatory agencies set water quality guidelines according to chemical concentration levels. Chemical procedures have been standardized and well documented. Test kits and equipment are, for the most part, readily available. On the down side, analysis equipment may be expensive and complex. More importantly, current methods are often impractical for volunteer monitoring programs when specific preservation methods or limited holding times are involved. Recently, some volunteer monitoring groups have shown less formal and stringent procedures still provide useful data. Here again, quality control and assurance procedures are important to document.

The other concern with chemical measurements is that they represent conditions at the time of sampling that might not be indicative or consistent

with the actual water quality conditions. This may occur because of various interactive biochemical activities that cause daily cycles. On a sunny day, photosynthesis by algae in the water may cause an increase in oxygen and pH until evening when plant respiration causes a decline in both factors.

More recently, many volunteer groups have turned to the monitoring of living organisms as bio-indicators of environmental quality. Some species or groups of aquatic organisms have been found to be more tolerant than others to various forms of pollution. Also, for most situations, the more diverse a particular aquatic community is, the healthier it is. In addition, these organisms tend to integrate the water quality conditions occurring through a longer time period than most chemical monitoring techniques; chemical analysis of water a few days after a pollution event may not indicate any problem, but the presence of only pollution tolerant critters or no life at all will certainly raise suspicions.

The most popular organisms to sample are the benthic macroinvertebrates, mostly aquatic insect larvae, that spend a good part of their life cycle at the bottom of lakes, rivers, streams and estuaries. Stream monitoring programs have taken the lead with a variety of standardized sampling procedures and interpretive indices, from the simple to the complex, that relate type and numbers of organisms collected to the water and habitat quality. Estuary groups are currently working on developing invertebrate indices although this will be very challenging due to the dynamic nature of these systems (a wide range of salinities, temperatures and tidal cycles).

More common to estuary and wetland monitoring groups are bird surveys. Here again, the type of birds can be indicative of the habitat quality. For lakes, we are currently investigating the use of fish condition (length to weight relationships) and growth information collected by examining the fish scale growth rings. Preliminary results are very promising. Fish and birds rely on the intricate food web structure of the monitored resource as well as habitat conditions. Any perturbations in the system should create repercussions that can be measured by population condition, structure and size.

As with the other forms of monitoring, bio-indicator sampling has its limitations. The results of certain indices may be misleading or inappropriate for the particular study area or region. Many sites along the same stream may not be comparable due to changing bottom type and other factors (some programs try to get around this by setting their own rock baskets into a stream to bracket an area of concern). In addition, the cause of the problem is often not apparent from bio-indicator monitoring. Also of concern is that certain state and federal agencies might not readily accept these data and favor chemical monitoring results.

While observational monitoring may not offer the excitement of collection and analysis, many programs have had success in locating problem areas, identifying offending land uses and influencing improved legislation and behavioral change. Documenting the types of litter on our beaches, reporting construction sites in violation of sediment control regulations and providing photo-documentation of pollution can be a real eye opener to decision-makers. Watershed walks and similar resource investigation/inventory programs can be instrumental in locating those areas your monitoring group should study further.

CONSIDERING SAMPLING SITE LOCATIONS

Along with your procedures, careful thought must be given to sampling site locations. Again, your data objectives come into play. Consider the possible objectives of a volunteer lake monitoring program. If you want to conduct an assessment of the overall character of a lake you might choose to sample over the deepest waters. If your monitoring concerns involve detection of problem areas within or around a lake, you need to sample more sites such as shallow basins, coves or other areas where impacts might be occurring (recreational areas, beaches, marinas and developments). Besides shoreline and shallow water sampling, tributaries are important to monitor to detect impacts from the surrounding watershed. If a tributary is found to be suspect, the next step would be to determine the source or sources of the problem.

Estuary, wetland, river and stream programs need to address similar questions. For most new programs the task can be simplified. Unless there are known problem areas, the general approach would be to start with a basic program that assesses the quality of the resource. If a poor situation or decline is detected, move to the next level of sampling to determine the problem and the areas of impact. The next step is to consider possible solutions and involve your local or state agency for assistance in addressing the problem.

HOW FREQUENTLY SHOULD YOU SAMPLE?

With the procedures and locations chosen you are still left with another important set of considerations involving sampling intervals and frequency. Do you sample your estuary site during high tide, low tide or both? If your resources are limited, should you sample your river during low flow or high flow occasions? What about storm sampling? Do you conduct your shoreline survey in the fall when the leaves are down and you can see land use easier or do you do it late summer when algae and emergent plant growth are at their maximum? How much sampling is necessary to detect significant changes? There are no easy answers to these questions and your final decision will often be constrained by your finances, volunteer availability and your data analysis capabilities .

A basic understanding of the typical daily, weekly, seasonal and annual cycles that occur within your study system for the parameters you are measuring is integral in determining sample timing and frequency. If your data objective is to measure impacts, you may only have to sample before and after a storm event or a certain activity of concern. Resource inventories and surveys, educational or supplemental programs to existing monitoring operations will also have more straightforward considerations. Baseline condition and long-term trend analysis programs need to have frequent sampling to discern the true-trend signal from the interference caused by external factors that include climate changes, storm events, tidal fluctuations, water table fluctuations and short-term impacts. Some other important factors to consider are water withdrawal and drawdown schedules, migrations, stocking occurrences and recreational use patterns.

FINAL COMMENTS

The intent of this review was to examine the process for which to design a successful monitoring program. The process seems to be complex, but remember that this discussion attempts to cover some lake, stream, river, estuary, wetland and coastal monitoring situations. While certain considerations will be universal to all programs, many can be narrowed down for your particular program objectives. The questions posed are in no way complete, but it is hoped that they provide a good foundation to build on. Volunteer monitoring programs across the country are gaining recognition and acceptance. The key to your program's success lies in deciding what your objectives are and choosing the appropriate procedures, sampling sites and sampling schedule for your available resources that will provide the proper information to accomplish your goals.

DEVELOPING A NATIONAL COASTAL DATABASE

Janet Pawlukiewicz
U.S. Environmental Protection Agency

Virginia Tippie
Coastal America

Norm Edwards
Coastal America

A COASTAL ENVIRONMENTAL REFERENCE AND RETRIEVAL SYSTEM

The Coastal America Partnership recognizes that there is no simple way to find out which government agencies are doing what in the coastal environment. No single coastal information system or clearinghouse (for data and education/information materials) exists. Coastal America believes that a needed service can be provided by developing a comprehensive coastal reference and retrieval system (Coastal R & R).

To explore the concept of a user-friendly coastal reference and retrieval system for citizen monitors and the general public, several interactive workshops were held at the Third National Citizens' Volunteer Monitoring Conference. Participants were asked to respond to the following questions:

- Who will use the system?
- Where will the system be used?
- What should be included in the system?
- What other issues need to be addressed?

PROJECT DESCRIPTION

The Coastal America partners presented the concept of the coastal information reference and retrieval system which includes the following:

Goals

- Simplify public and government access to coastal data sources and information materials.
- Stimulate interest in the coastal environment.
- Encourage people to take action.

Objective

- Through one source, provide accurate, clear coastal information materials and/or complete referrals.

Plan of Action for 1992 - 1993

- Gather materials and referral information to build the Coastal R & R information system database.
- Determine what information should be included.
- Determine appropriate user communities and their needs.
- Determine computer technology most appropriate to user needs.
- Pilot test the Coastal R & R system.
- Develop marketing and training strategies.
- Develop public-private partnerships to help minimize the costs to the government and the public for distribution of the system, necessary equipment/software and training for users.

WORKSHOP SUMMARY

Those who participated in the workshop felt that a need existed for a coastal environmental reference and retrieval system. There also was agreement that users have differing needs and knowledge levels. Users also differ in access to and knowledge of computers. For these reasons, it was suggested that the system should be very user-friendly, with easy access from public places

(libraries, town halls, nature centers) and available to government agencies, schools and universities, researchers and the private sector.

Potential users were identified as educators, the general public, state and local government units, researchers, planners, the private sector and federal agencies with coastal resource management and development responsibilities.

There were also some specific issues raised during the workshops that need to be further explored, such as methods for marketing and distributing the system to users, updating information contained in the system, training users on the system and determining equipment costs. It was suggested that the Agricultural Extension Service, Marine Advisory Service and the National Science Teachers Association could help with distribution and training.

STATUS

A coastal reference and retrieval ad hoc group has been established to coordinate the effort. They will assess existing information systems to determine their applicability to the identified needs. Although it is CD-ROM based rather than an on-line system, the EPA Educational Clearinghouse appears to have the ability to serve some of the identified potential users of Coastal R & R, particularly the education community. Coastal America will continue to review EPA's work and may use the Clearinghouse to accomplish part or all of the Coastal R & R system purpose. Other information system options will continue to be explored.

The Coastal America partners are currently reviewing their agencies' materials to decide what information and/or data they wish to provide. The ad hoc group is concurrently determining what information to include from other sources. In addition, work has begun on the potential for developing a public/private partnership to minimize the costs of equipment, use, training and distribution.

VOLUNTEER MONITORING NEWSLETTER

Eleanor Ely

Editor, The Volunteer Monitor

PART I. PRESENTATION, NEWSLETTER HISTORY AND BACKGROUND INFORMATION

A. History

The idea for a national newsletter came out of the first national conference for volunteer monitors, held in Rhode Island in 1988. Conference participants recognized the need for a networking tool. It was felt that one group should not take on the newsletter project; instead, it should rotate among monitoring groups so that different points of view would be represented.

First Issue: Fall 1989 (vol. 1, no. 1): Produced as a one-time project by the Alliance for the Chesapeake Bay, with funding from EPA. All articles written by Alliance staff. Included an overview of many different kinds of monitoring programs around the country and a resource listing.

Fall 1990 (vol. 2, no.1): Published by Adopt-A-Beach in Seattle, Washington (edited by Eleanor Ely as subcontractor). Again a one-time project, funded by EPA. In response to suggestions made at second national conference (Dec. 1989, New Orleans), the following changes were made: Newsletter printed on recycled paper; emphasis on practical, hands-on information and technical tips; articles written by people from different programs (to create more of an information exchange).

Fall 1991 (vol. 3, no.1): Start of new ongoing arrangement: permanent editor, permanent editorial board (representing a variety of types of monitoring and geographical areas), and different monitoring groups serving as rotating co-editors for each issue. This structure gave the newsletter some stability and continuity while still allowing for different perspectives to be represented. Newsletter to be published twice per year with ongoing funding from EPA.

- Co-editors for Fall 1991: Virginia Lee of Salt Pond Watchers (RI) and Meg Kerr of River Rescue (RI)
- First issue with a theme (Biological Monitoring)

Spring 1992 (vol. 4, no. 1)

- Co-editors: Adopt-A-Stream in Washington
- Theme: Monitoring for Advocacy

Future: Fall 1992 (vol. 4, no. 2)

- Co-editors: Massachusetts Water Watch Partnership
- Theme: Building Credibility

B. Audience for Newsletter

Volunteer program managers; volunteer staff of state and federal water quality and environmental agencies; environmental preservation and advocacy groups; researchers and consultants.

C. Distribution

Print run of 10,000 for all issues through fall 1991; projected print run for spring 1992 of 15,000. Two-tiered distribution strategy:

1. Mailing list (about 4,000 names for fall 1991; will be between 7,000 and 8,000 for spring 1992). People on mailing list receive individual copies via bulk mailing. Preferable not to have individual volunteers on this list (too hard to keep up to date and too many names).

2. Batches for redistribution. Groups order large batches (often several hundred) for redistribution to their volunteers and others on their own mailing lists. Groups pay shipping charges. Possibility for future: Ask groups who want 100 or more copies to buy into the print run.

D. Newsletter Purposes and Goals

Facilitate the exchange of information

- Keep readers up to date on techniques and methods;
- Emphasize practical information and a how-to format;
- List useful resources (books, manuals, videos) along with complete ordering information.

Serve as a networking tool

- Keep readers up to date on what other volunteer monitoring groups are doing;
- Provide contact names, addresses, and phone numbers for programs mentioned in articles.

Represent the diversity and scope of monitoring programs

- Maintain a nationwide focus;
- Include articles by and about a variety of groups and activities (different kinds of water bodies, sizes of programs, types of monitoring).

Provide a forum for the exchange of ideas and opinions.

PART II. DISCUSSION

The following is a brief summary of the discussion that took place following the presentation.

1. Evaluation of newsletter content, tone and audience. Participants reported that they find the newsletter very useful, like the format and have found the tone appropriate for various audiences, including high school students.

2. Newsletter distribution.
   a. The consensus was that the newsletter needs to reach more non-East Coast people, particularly people in the Gulf states and the Midwest. People from under-represented areas will send suggested additions for the mailing list to the editor. Also, attendees will advertise the availability of *The Volunteer Monitor* in their own newsletters.
   b. Participants liked the idea of asking people who want 100 or more copies to buy into the print run. Cost will be about $15 per 100, which everyone thought was reasonable. This will allow more copies to be printed and distributed without requiring additional outside funding.

3. Frequency of publication. The consensus was to aim for four issues per year. Tentatively, try for three issues in 1993 and four in 1994 (if there is sufficient funding, time and material to be published).

4. Future themes. Working with Schools was chosen as the theme for spring 1993. Funding was also a popular idea for a future theme.

Day 2: Forming Private Partnerships

OPENING REMARKS

Virginia K. Tippie

Director, Coastal America

Good Morning. It is a pleasure to be here today for the Third National Citizens' Volunteer Water Monitoring Conference. Your goals and objectives are near and dear to my heart for I have been committed to citizen coastal monitoring programs throughout my career.

I know from my own professional experience in Rhode Island and the Chesapeake Bay that a well-designed volunteer program can significantly augment our monitoring efforts. More importantly, citizen monitoring efforts frequently provide an early warning signal of problems. Volunteer monitoring stations tend to be closer to shore and the sources of pollution, and can be sampled when unusual events occur, such as major storms or midnight dumps. It is clear that citizens must play a major role in the assessment and monitoring of our nation's waters.

The challenge we face is how to work together to achieve our common goal of restoring and protecting our nation's waters. Partnerships for action, or paralysis and inaction; coalitions or collisions. These phrases essentially characterize the struggle we face. If we have the will and imagination to create positive partnerships and constructive coalitions, we can avoid the paralyses of inaction and/or destructive collisions. It is therefore very appropriate that your theme for this year's conference is building partnerships and learning how we can work together to assess, monitor and restore our nation's waters. This morning, I would like to discuss the importance of citizen volunteers in all aspects of a water resource program and then discuss some ideas for building partnerships.

VOLUNTEERS AND WATER RESOURCE PROGRAMS

In my mind, there are three major components to an effective resource program:

1. Research studies to assess environmental problems and determine cause and effect;
2. Monitoring programs to document the status and evaluate trends in environmental health;
3. Management actions and individual initiatives to restore environmental quality.

This three-step approach to water resource management is a logical, rational way to deal with the immense water quality problems facing us now and in the future. The only problem is this is not a rational world. It is a world constrained by political reality, economic forces and societal attitudes. For this reason, citizen involvement in all aspects of a water-resource program becomes very important. It is a concerned citizenry that changes political positions, economic factors and societal attitudes.

The biggest challenge ahead in environmental research is determining cause and effect in an ecosystem context. To meet this challenge, we need to increase our environmental effects research and improve our understanding of ecological integrity. We need to do the kind of research that clarifies the ecological mechanisms controlling cause-effect relationships. Citizen monitoring programs can often provide the missing link that enables us to determine cause-effect. It was data collected by citizens that helped to make the case of the DDT eggshell linkage.

On the coastal front, the Rhode Island Salt Pond Watchers have provided university researchers with invaluable data which has significantly improved our understanding of the ecology of the ponds. In fact, I recall from my University of Rhode Island days, a five-year interdisciplinary study of the Salt Ponds in which volunteer data were used to docu-

ment macro-algal blooms, determine fish catch per unit effort and assess the waterfowl population.

Citizens have also provided invaluable research information on unusual events. In the Chesapeake, citizen monitors were able to capture the effects of Hurricane Gloria and Tropical Storm Juan on the suspended sediment levels of the James River. I was technical director of the EPA Chesapeake Bay Program at the time, and as a marine geologist who specialized in sediment transport problems, I was excited by the data. A three-dimensional plot of the secchi disk data from Richmond to Virginia Beach over the period from August 17 to November 20, 1985 showed the pulse effect of these two major storm events. As a scientist from Virginia Institute of Marine Sciences said, "If a picture is worth a thousand words, then this plot is worth ten thousand numbers."

With regard to monitoring, the key question is how do we measure the effectiveness of our management programs. As a scientist, I believe we need a comprehensive monitoring system that tracks the status and trends in water quality and evaluates the ecological response. We need a system that can give a clear, irrefutable signal of any impending threats in time to begin the often lengthy process of responding to those threats. We need to identify easily measurable ecological indicators. In other words, is there an equivalent to the miner's yellow canary for clean water to give us the advance notice necessary to take action? Needless to say, volunteer monitoring programs can significantly augment the long-term data sets that help us identify hot spots and detect trends which can provide important early warning signals.

The National Weather Service can attest to the critical importance of a citizens' monitoring program with 11,500 volunteers nationwide and over 100 years of experience. This program has provided time-critical information to forecasters regarding the development of severe storm events such as tornadoes and hurricanes. These volunteer weather men and women have saved lives! They have also provided the long-term climatological database that is helping us monitor climate change.

On the waterfront, Save Our Streams (SOS) has been collecting water-quality data since 1970 in various states. The data sets collected by SOS projects in selected streams have been useful in assessing the impact of management actions and in educating local communities on what they can do to save their streams. This, in turn, has helped change public attitudes towards the creeks and streams that are the life blood of this country.

Volunteer monitoring programs, such as the watchdog operations of the River Bay Keepers and the clean-up efforts of the Adopt-a-Beach or river programs, can really have an impact on management, which is the third component of a water resource program. I was talking to the San Francisco Bay Keeper the other day and was pleased to find that there are now seven keeper programs. I was also impressed that the San Francisco Bay Keeper program uncovered a significant case of illegal midnight dredging which resulted in a $200,000 fine. When watchdog efforts like this result in major fines, it sends a strong signal to industry.

However, cleaning up our nation's waters will take more than enforcement actions against current violators. We need to address the sins of our past which come back to haunt us as debris along our shores. The National Coastal Clean-up effort of the Center for Marine Conservation is a good example of an action-oriented effort that addresses this problem. With more than 100,000 volunteers in 32 states and 12 foreign countries, they pick up a tremendous amount of trash and remove it from the system. The tallied information also helps us evaluate the effectiveness of our management actions and educational efforts. Although some beach areas are improving, we're still finding that over 60 percent of the debris found during beach cleanups is plastic, even though the MARPOL international agreement banned the dumping of plastics.

BUILDING AND EXPANDING OUR PARTNERSHIPS

These examples are only a few of the many volunteer monitoring success stories that have made a difference. The challenge we face in the future is how to better link these efforts internally with one

another and externally with government agencies and the private sector. In other words, our challenge is to do a better job of building and expanding partnerships. The key is to network internally and reach out externally - simple concepts but rather difficult to implement.

Internally: The various volunteer monitoring groups need to share and exchange information on a regular basis. Conferences such as this one are important, as is the national volunteer monitoring newsletter, *The Volunteer Monitor.* I also hope you will move forward with the concept of establishing a national volunteer monitoring society. The formation of such an alliance will give you a greater voice. In addition, a national shared data system which is user friendly would empower citizen groups. As the old saying goes, knowledge is power. Just imagine the impact of a state of the coast report that really discussed the health of the system and tracked our management actions at all levels.

Externally: We need to reach out and create partnerships between citizen groups, government agencies and the private sector. Throughout the country we're seeing strange bedfellows joining forces to accomplish specific tasks in the environment. I am most familiar with two very positive efforts, the Aransas National Wildlife Refuge Shoreline Protection Project in Texas and the Florida Marine Resource Council Program.

The Aransas project has involved approximately 1,000 volunteers working to stabilize the shoreline and restore the habitat of the endangered whooping crane along the Gulf Intracoastal waterway. Partners include CONOCO, marine barge companies, conservation groups and federal/state agencies. What a team! In fact, the project was chosen national winner of the President's Take Pride in America Award.

The Florida Marine Resources Council (MRC) forged an exciting partnership between government, businesses and civic groups to manage the economic and environmental values of the Indian River. In recognition of its effort, MRC received one of the President's 1991 Environment and Conservation Challenge Awards. We need to continue to encourage partnership efforts through such recognition. In fact, I would like to see the proposed national volunteer monitoring alliance establish its own national recognition award for partnership efforts.

We are often thwarted in our efforts to create partnerships by the myriad of dis-integrated environmental programs. We have a lot of different agencies and groups mucking around in the same mud. It is apparent that the complexity of water-quality problems is only matched by the complexity of the legislative mandates that direct our national response to those problems.

One effort to better integrate our programs and cut through the red tape of bureaucracy is a new Presidential Initiative called Coastal America. This program is a partnership of the federal agencies with management responsibilities in the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the Corps of Engineers and the Department of the Interior. By leveraging expertise, funding and statutory authorities, the administration is beginning to mount an attack on the problems of coastal pollution and habitat loss. We are creating partnerships for action or coalitions that prevent collisions and the paralysis of inaction.

Projects are shovel-in-the-ground, action-oriented management efforts with a minimum of three federal agencies and a state/local agency and/or non-governmental organizations. The private sector participation has been significant; our projects this year have over 50 percent match. Projects must also have a citizen education and monitoring component. Your organizations could help, so please send us your ideas and join our effort.

In summary, each and every one of us can make a difference, but only if we pull together and create a strong alliance for the stewardship of our nation's waters. As partners caring for our environment, government, the private sector and citizens can and will preserve, protect and manage our precious water resources for countless future generations.

PARTNERSHIPS WITH ENVIRONMENTAL AND EDUCATIONAL ORGANIZATIONS

Panelists: Valerie Fons Kruger, Grand River Expedition '90; Patrick Reese, Friends of the Fox River; and Inga Adams and Chani Gilfeather, Colorado River Watch Network.

Valerie Fons Kruger

Grand River Expedition'90

PARTNERSHIPS FOR WATER QUALITY

Grand River Expedition '90 is a 501(C)(3) non-profit organization dedicated to river study, cleanup, protection and environmental education in the Grand River Watershed of Michigan. The organization began in 1989 with the intent of producing a highly visible, structured river study and journey of discovery to explore and document the values, problems and opportunities of the Grand River and its 5,570-square-mile watershed.

In August 1990, a multi-disciplinary team of 120 people including scientists, technicians, historians, educators, students, agriculture and natural resource professionals, industry representatives, leaders in civic organizations, associations, employees and volunteers of local, state and federal government, native Americans and other ethnic/cultural representatives, writers, video/film specialists and private citizens, paddled the 240-mile length of Michigan's longest river. Leadership for the expedition was provided by Valerie and Verlen Kruger. Each of the 55 canoe teams conducted individual or agency studies in one of four areas: environment, history, recreation and education. From these studies, team members created over 40 interactive displays and demonstrations to present as a traveling riverfest to people along the route and to communities who hosted the expedition at scheduled noon meals and evening camping spots.

Grand River Expedition'90 was successful in contributing knowledge, appreciation and awareness of responsibility for the Grand River, which has connected communities across the Water Wonderland State throughout history and will continue to do so into the future.

The goals of the expedition were as follows:

1. Create a database on the present condition and past history of the river.
2. Identify issues that relate to knowledge of the river resource, including river conservation measures that respond to local needs and problems.
3. Foster public awareness of the river and the watershed concept including river responsibility.
4. Increase knowledge and appreciation of the river.
5. Build partnerships in business, government, education and public involvement in river use and water quality.
6. Serve as a springboard for further watershed studies influencing future projects, including river cleanup and watershed management, and serve as a model for other river projects throughout the nation.

Grand River Expedition'90 reached and exceeded these stated objectives. Due to the efforts of expedition members, in the two years following the river expedition citizen sub-watershed groups formed on each of the Grand River Tributaries. Individual and agency displays, workshops and lectures created from the river experience were presented throughout the watershed at symposiums, river festivals and special programs. Grand River Expedition'90 became an umbrella organization for Beautification '91, an extensive river cleanup sponsored by General Motors/UAW Jobs Bank Program, which al-

lowed 50 General Motors employees to work for two months cleaning the Grand River.

In 1991, Grand River Expedition'90 won the State of Michigan Award in the Take Pride In America campaign. In 1992, an Expedition '90 member organized the Grand River Project in the upper watershed. This 27-member group, including Consumers Power and the County and City of Jackson, is presently working on a canoe trail system, interschool database, a Grand River Park and Native American Learning Center. Grand River Expedition has become a resource group with voice and action in watershed management, and a model for river programs throughout the nation.

Since the founding of Grand River Expedition '90, our strong points have been thinking big; promoting an attitude of inclusion, encouragement and working together; avoiding blame placing for problems discovered; and sharing the excitement of adventure and actual river experience to promote and protect water resources.

When Grand River Expedition '90 got people into the river, lives were changed. We took a step beyond forming partnerships and found ourselves building relationships. As our lives changed in relation to the river and one another, we began to see that it takes more than water to make the river grand. It takes everybody working hand in hand. Our motivation is fueled by the ever-flowing river that we have come to know and love, and the changes we have seen take place due to our efforts and work together. Grand River Expedition '90 made a huge difference and served as a catalyst for individual and agency commitment to major watershed activities.

Patrick Reese

Friends of the Fox River, Inc.

STARTING A STREAM MONITORING NETWORK

The Friends Stream Monitoring Network is an environmental education and citizen action program based on an easy-to-learn biological water quality monitoring activity. Teachers, leaders of youth groups, and others are trained at workshops to adopt-a-riffle with their students and provide scientific water quality data.

The monitoring activity is incorporated into existing environmental studies in grades four through 12, similar to a Project Wild activity. Additionally, teachers have the option of involving their students in a more comprehensive curriculum which can be adapted to any grade level.

Starting a volunteer water monitoring network can be simple, rewarding and inexpensive for a membership-based conservation organization. You'll find that in providing structure for a program, a lot of exciting and committed people will become involved. To launch a program, you'll need an experienced leader with the time and commitment to pull all the essential organizational elements together. Next you'll need to recruit a network coordinator, adopt a technical reference manual, and bring together an advisory committee of resource people who can volunteer the expertise needed to help design, administer and fund a program.

In our case, we based our program on a technical reference which is modeled after the Izaak Walton League of America's Save Our Streams Program, entitled *Citizen Stream Monitoring: A Manual For Illinois.* This manual is a complete and easy to understand curriculum on the ecology and monitoring of streams.

We recruited the regional superintendent of schools to fund training workshops, assist with printing and help conduct mailings. EPA scientists, university professors, teachers, naturalists and others volunteered time to conduct workshops, order and distribute equipment, map riffles, maintain a computerized database, and publish a newsletter.

It's an added benefit when advisory committee members have the support of their employers or are in a position to allocate some of their resources and work time to the program. In the future, growth of the network may require funding a paid coordinator.

We began this program in July 1990. Today, 123 classrooms and eight citizen groups have adopted riffles and are monitoring the 195-mile Fox River system in Wisconsin and Illinois.

We hold basin-wide training workshops twice per year. In the morning session, participants receive classroom instruction and learn about watersheds, water cycles, stream ecology, Fox River issues, pollution sources and causes, best management practices, the biological monitoring activity and citizen action opportunities. In the afternoon, participants receive hands-on, in-stream training in benthic macroinvertebrate identification and the biological monitoring procedure. They learn how to chart a Stream Monitoring Assessment Form for a water quality rating.

Teachers and citizens who want to join the network submit a Planning and Needs Assessment Sheet with a Letter of Agreement, co-signed by their principal or supervisor. The Friend's Fox River Education Advisory Committee then selects those most qualified to join the network.

The Friends agree to supply monitoring groups with materials and equipment on a permanent on-loan basis. These supplies are donated and include: a program manual, an educational poster with basin map and historical time-line, a video documenting pollution sources and causes, a training video illustrating the biological monitoring procedure and benthic macroinvertebrate identification, a technical reference manual, netting material, and specimen boxes with magnifier lids.

Selected groups agree to construct collection nets, provide transportation to the stream site, monitor their adopted riffle four to six times per year (the same riffle can be monitored by more than one group at different times to achieve this standard), submit water quality data, and select four students to attend the annual Student Congress.

Teachers welcome the opportunity for training because they often lack the background, curriculum or materials necessary to teach about local environmental issues. The Friends give teachers the opportunity to share newly acquired environmental knowledge and teaching skills with their students. Students love the program because its builds self esteem. They realize they are citizens too and part of a larger team conducting real world research vital to protecting and restoring a polluted and endangered river system.

Each spring, students and their teachers come together at an annual Student Congress to identify water quality problems, share data, attend skill-building workshops and develop an action agenda for their communities and the watershed.

Our goal is to help raise a new generation of adult decision-makers able to resolve complex socio-environmental problems and empower the watershed's 1.5 million residents with the knowledge, skills and confidence necessary to take responsible steps to benefit the water quality, ecology, habitat and scenic resources of the Fox River system.

Note: A free copy of *Citizen Stream Monitoring: A Manual For Illinois* can be ordered through the ENR Clearinghouse at 217-785-2800. The Friends program manual can be purchased for $40.

Chani Gilfeather

L. B. Johnson High School
Colorado River Watch Network

Inga Adams

Westwood High School
Colorado River Watch Network

MONITORING THE COLORADO RIVER

The Colorado River Watch Network (CRWN) is a web of water-quality monitoring stations that reaches from San Saba, Texas, to the Gulf of Mexico. We test for approximately 10 parameters which include chemical as well as biological tests. The network, which is supported by the Lower Colorado River Authority (LCRA), is made up of teachers, students and citizen monitors. Age levels range from fourth graders to senior citizens, with over 600 participants and a long waiting list of aspirants.

RECENT ACTIVITIES

QA/QC Quarterly Symposiums for all monitors

- Phosphate ban supported by CRWN data and initiated by concerned student monitors.
- CRWN receives funds from the city of Austin to establish a youth-at-risk environmental incentive program in local schools.
- Students brief director of the EPA.
- Annual 24-hour water-monitoring study (diurnal) receives extensive attention from the environmental community and the media.
- CRWN featured in many newspaper articles and public access television programs.
- CRWN receives two environmental awards for environmental education and action from a prominent local environmental association.

PERSONAL EDUCATIONAL VALUE

A. Value to the monitors in general
   - students and teachers
   - citizens

B. Our personal growth

COLLABORATORS

- Lower Colorado River Authority
- Local communities
- Local governments
- State legislators
- Central Texas school boards
- National river watch organization
- Private citizens
- Environmental community

TRAINERS

Experienced CRWN student monitors train all incoming monitors. They also participate in outreach programs and demonstrations to the public, different communities, government officials and children.

PARTNERSHIPS WITH BUSINESSES

Panelists: Meg Kerr, University of Rhode Island; Ron Bruner, Society of the Plastics Industry; and Joe Gorsuch, Eastman Kodak Company.

Meg Kerr

University of Rhode Island

RIVER RESCUE PROGRAM

While volunteer monitoring is well established in Rhode Island, the state's newest program, River Rescue, is in many ways a landmark for volunteer monitoring nationwide. The uniqueness of River Rescue lies in the partnership between its corporate sponsor, Citizens Bank, and the University of Rhode Island (URI) and Rhode Island Sea Grant. This private/public sector partnership is one of the first of its kind in the country.

In 1989, Citizens Bank was in the process of building their new headquarters facility at the confluence of the Moshassuck and Woonasquatucket Rivers in downtown Providence. They approached URI with the idea of establishing a major environmental public service project. The bank was interested in developing a program that could help address the quality of the water in Rhode Island's urban rivers, while involving employees in volunteer efforts along with members of the community. River Rescue grew out of these discussions.

River Rescue volunteers monitor four urban rivers that flow into the upper reaches of Narragansett Bay. These rivers have received industrial and domestic wastes for more than 100 years and are the largest contributors of point source pollution to the bay. During the last ten years, millions of dollars have been spent to improve the condition of these rivers. Even greater amounts are planned for the future. But little data is available to evaluate whether these improvements have had their desired effect on the rivers. River Rescue was designed to answer the following questions:

1. What is the current condition of these rivers?
2. What are the sources of pollution to the rivers?
3. How has the condition changed over time?
4. What pollutant loading do these rivers send to Narragansett Bay?

For the first three years of the River Rescue project, Citizens Bank committed over $31,000 and more than 1,000 hours of staff time per year. The bank provides promotional and financial support for River Rescue while the university oversees the technical aspects of the monitoring effort and provides the essential link with scientists, state regulators and local governments. Sea Grant provides supplemental funding and technical assistance.

According to Herbert W. Cummings, president of Citizens Bank, two basic concerns had to be addressed before the bank would commit such a substantial amount of money and staff time to the program. The first concern was that River Rescue be an honest program that would address real needs of our rivers and help to bring about positive change. The second concern was that River Rescue make business sense for Citizens Bank.

River Rescue has successfully met both criteria. In the course of its first year, River Rescue established itself as a credible monitoring program which can provide useful data. The program also makes good business sense for the bank for the following reasons:

1. Citizens Bank is a major property owner along the river. The value of the bank's

investment is clearly affected by the quality and appearance of the rivers.

2. River Rescue offers numerous opportunities for positive publicity about the bank.
3. All banks offer the same products. River Rescue helps differentiate Citizens Bank from its competition.
4. River Rescue provides the bank with an opportunity to get its employees involved in a major public service campaign. More than 100 bank employees and family members have volunteered for River Rescue projects. The program has had a very positive effect on employee morale. Volunteers are proud to be working for a bank that cares about the environment.
5. In the long term, clean rivers will help attract new business to the area and will encourage existing businesses to increase their investment. The quality of the rivers also has a dramatic effect on Narragansett Bay, which impacts Rhode Island's economy, both for recreational and commercial applications.

Citizens Bank employees have shown a strong interest in the program. Approximately one third of the 70 volunteers are bank employees. Employees have enthusiastically supported River Rescue special events, such as stream bank cleanups and fundraising events.

Citizens Bank's participation in the program may also have implications for other corporations considering environmental partnerships. With this in mind, Citizens has begun an outreach program to encourage other businesses and community groups to become involved in River Rescue. To date, a law firm, a computer firm and members of the Providence Fire Department are participating in the program. Several other companies have shown strong interest in the program and discussions are underway to develop activities that meet their individual needs.

While it will take years to achieve the technical objectives of the River Rescue program, this unique program has already received the support of the Rhode Island Department of Environmental Management, local environmental groups and the scientific community. In a time of diminishing government funding for volunteer programs, the need for alternative funding will continue to rise. River Rescue is proof that given a strong commitment by all parties, private/public partnerships can work. Its example may well provide a model for the development of similar alliances for water-quality monitoring programs across the country.

Ronald G. Bruner

The Society of the Plastics Industry, Inc.

FORMING PARTNERSHIPS

Several days after I was invited to serve on this panel, I got a follow-up letter with the advance conference agenda. As I looked through that agenda, I had a somewhat uneasy feeling that maybe the invitation was really meant for someone else. After all, what did I know about monitoring surface waters, testing for chemicals and identifying biological pollutants? Essentially nothing. My experience with water quality was in the area of marine debris, the visible — not the invisible — stuff in water.

But the more I looked at the agenda, the more I saw the word partnerships. It was at this point that I decided maybe the invitation had not been in error because I do have some experiences to share with you in that area regarding the Society of the Plastics Industry (SPI).

Compared to some of you, I'm a newcomer to water quality efforts. It has only been since early 1986 that I've had the opportunity to work closely with the Center for Marine Conservation (CMC) and the National Oceanic and Atmospheric Administration (NOAA) on efforts to reduce marine debris.

The impacts of marine debris are increasingly well recognized, and they generally fall into five categories: aesthetics, entanglement, ingestion, ves-

sel disablement and economics. Perhaps less known are the many sources of marine debris. They range from merchant ships, cruise lines and fishing fleets to pleasure boaters, beach goers, manufacturing activities and antiquated sewer systems. In fact, the list is long and varied.

Without recounting the history of how SPI, CMC and NOAA came to work together, I'll simply say that discussions in mid-1986 led to the realization that we all had the same goal, to keep plastics out of the ocean.

You may have noticed that's the first time I've mentioned the word plastics. Unfortunately, it's hard to talk about marine debris without talking about plastics. The cold reality is that the majority of marine debris is plastic. Statistical studies have demonstrated that time and again.

My next point may sound like a commercial message, but appreciation of it will help you understand the foundation that has helped pull our partnership together. Plastic has many qualities that make it ideal for uses on or near the water. It is durable, lightweight, shatter resistant, waterproof and it doesn't rust. The problem comes when someone improperly, or carelessly, disposes of plastic products in the marine environment.

We found that our common ground was a desire to educate target audiences about the proper disposal of plastics. Our joint educational campaign started in 1987. The initial focus was a series of public service print ads for use in publications targeted at five specific audiences: commercial shippers, the fishing industry, the plastics industry, pleasure boaters and recreational fishermen. Media briefings, brochures, guidebooks, posters, television public service announcements, conference exhibits and a host of other materials also are part of the effort. Perhaps one of the most visible and successful aspects of the educational campaign has been beach cleanups.

The materials I've just mentioned are some of the end-products of our efforts. But given the focus of this conference, perhaps more important for you is understanding how our three organizations worked to make them happen.

In most cases, CMC provided the people while SPI (and NOAA) provided financial resources. Through SPI and our individual member companies, the plastics industry made grants for printing and distributing materials to support participation and to jump-start state infrastructures for beach cleanups. Not all of our contributions were monetary, though. Tens of thousands of trash bags were provided for beach cleanups. SPI arranged for pro bono agency work to facilitate development of the public service ads, and SPI personnel travelled extensively with CMC staff to help tell the story.

Obviously, time constraints force me to skim the surface of these activities. With my few remaining minutes, I want to share with you my perspective on creating a successful partnership. You might think of this as a recipe, an old-fashioned recipe like the kind you'd find in you grandmother's cookbook that says add a pinch of this or a dash of that.

SEVEN STEPS FOR A SUCCESSFUL PARTNERSHIP

Step 1: Start with one measure of level-headed desire to do what is right for the environment. This ingredient shouldn't be hard to find; however, given the current recession, you may have to look a little harder than usual. It's not that people don't care about the environment, it's that they're focusing time and resources on keeping bottom-lines in the black and businesses out of bankruptcy.

Step 2: Add equal quantities of willingness to listen, willingness to learn, and willingness to change. Sorting fact from fiction has never been more difficult. Just because you've read something in a newspaper or magazine, or seen it on television, doesn't necessarily make it so. The world is full of myths, often perpetuated in the media. Be prepared to adjust your viewpoints based on first-hand experiences. Personally, my understanding and appreciation of the marine debris problem escalated sharply after participating in a beach cleanup on Padre Island in Texas in 1986.

Step 3: Sprinkle with a layer of statesmanship. Your partnership should have at least a few people who aren't afraid to stray from the path of tradition. You'll need wise political leadership with narrow

partisanship. Stalemates get broken and progress made when someone is willing to blaze new trails.

Step 4: Whip up liberal amounts of enthusiasm with a dash of patience. It's not enough to recruit a few willing allies to your cause. You'll need lots of helping hands. In the case of the beach cleanups, what started with a few thousand participants in one state has grown to encompass more than 100,000 people nationwide annually...and it has now moved into the international arena.

Step 5: Stir in as much common ground as you can find. Look for areas of agreement, not disagreement. This may be the single most important step in building a partnership. Without it, you won't have any foundation to build upon. In the case of marine debris, we — CMC, NOAA and SPI — all agreed that discarded plastics don't belong in the marine environment. We were able to build our program on that common ground.

Step 6: Add a variety of benefits. Recognize that everybody in the partnership should derive a benefit, but having said that let me add that no single group in the partnership can be the winner. The only BIG winner should be an ultimate, higher cause, in this case the environment.

Step 7: Sprinkle with some crushed Rolaids. There will be some heartburn along the way, I can assure you of that. It happens when you first present those public service ads to your board of directors — ads that are far more candid than anything your organization has ever done before. Or when a colleague takes you to task in public for working with "the other side" on the issue. Nobody has cornered the market in slings and arrows. We've seen them fly in all directions while pursuing our joint educational effort.

In closing, let me offer these final words. When you set out to form a partnership, you'll hear lots of reasons why it won't succeed: They'll never work with us on this, or our members won't like it if we work with them, or we'll never raise enough money to make a difference. Don't be too ready to accept such snap judgements. Be wise enough to throw away the book on conventional wisdom.

Joseph W. Gorsuch Sr.

Eastman Kodak Company

EASTMAN KODAK COMPANY AND BENJAMIN FRANKLIN HIGH SCHOOL ADOPT-A-STREAM PROGRAM

In 1987, the Eastman Kodak Company Environmental Sciences Section (ESS) of the Corporate Health and Environment Laboratories formed a partnership with the Rochester City School District Charlotte High School Environmental Science Magnet, which moved a year later to Benjamin Franklin High School. This partnership provided opportunities to help Environmental Science Magnet (renamed Biosciences and Health Careers Academy in 1989) students to better understand environmental issues. One focus of this partnership is a program called Adopt-A-Stream. The material for this program was prepared by Rochester-based Delta Labs, a nonprofit company that analyzes chemical and biological samples.

As a concerned parent interested in sharing my enthusiasm for environmental sciences, I participated in the development of the Environmental Sciences magnet school curriculum between 1984 and 1987. Also, seeing the need in the classroom, I arranged to have Kodak donate some surplus equipment for use by the students. Once the corporate Kodak partnership with Charlotte High School was formed in 1987, this new relationship allowed for formal involvement of volunteers from my entire group. Jay Costanza, a biosciences teacher at Franklin High School, spent three summers working in my laboratory. During Costanza's second summer, we developed the Adopt-A-Stream Program for his ninth-grade students. In preparation for the annual spring Adopt-A-Stream event, which takes place on Oatka Creek, about 20 miles south of Rochester, New York, the ESS staff visited the classroom to mentor the students' progress in learning to identify benthic macroinvertebrates; use water chemistry test kits; and collect, record and analyze chemical and physical parameters from bodies of water.

Oatka Creek supports both warm water and cold water fisheries. The segment of the creek that was studied by the students in the Bioscience Academy supports a unique habitat for populations of natural breeding rainbow, brook and brown trout. Members of the Seth Green Chapter of Trout Unlimited are extremely interested in knowing the impact of the sprawling urban developments approaching the Oatka Creek watershed. After being approached by Trout Unlimited, Costanza and I decided that Oatka Creek would provide an excellent opportunity for the Bioscience Academy students to practice their classroom experiences in determining the quality of stream life and dynamics of ecology.

Most waterways today have the potential of being touched by some sort of pollution. The streams in the Rochester, New York, rural area aren't any different. The high school students collected and analyzed the water from the stream. If the data were questionable, Delta Labs would recheck the samples to see if the proper analysis techniques were used. ESS staff helped students analyze the water for hardness, phosphates, nitrates, ammonia, zinc, copper, iron, dissolved oxygen and carbon dioxide, color, turbidity, temperature and acidity. Depth, stream-flow rate, and stream substrate were also determined. ESS staff assisted students in identifying aquatic life such as insect larvae (mayflies, caddisflies, midge flies, and water striders), which are necessary for trout survival. Costanza and the bioscience students plan to continue analyzing water samples and aquatic organisms for the next five to ten years to ensure that the natural breeding of the trout in Oatka Creek continues. Bioscience students will compile the new data they collect, compare them with data from previous years, and submit a report of their finding to their science teacher. These reports will be shared with the Seth Green Chapter of Trout Unlimited. The results of these efforts have proven to be valuable. To date, all the data have indicated a negative impact from urban development in the Oatka Creek watershed. In late January 1992, Chief Fisheries Biologist Karl Widmer of the New York State Department of Environmental Conservation informed me that the trout population is doing well, and in fact, it has expanded its range.

By participating in the Adopt-A-Stream project, students learn things that are relevant outside the classroom. Efforts to protect the environment are going on everyday at Kodak where studies to determine the effects of chemicals on aquatic and plant life are conducted. My staff and I bring aquatic organisms used in aquatic bioassays into the classroom and describe to the students exactly why Kodak looks at these organisms, how they fit into the food chain, and why they are considered indicators of water quality. As a result of this in-class analysis, students have learned to identify these organisms, how to find them, what equipment to use to collect them in the wild, and the techniques involved to study them.

The Adopt-A-Stream Program is built on the premise that our youth must be educated if we are going to do something positive about the problems in the environment. If we educate the students, and they start getting involved in environmental issues, they will begin to understand how important preserving our environment is. By seeing first-hand what can be done to measure environmental change, they can begin to understand what to do to protect the future of the environment.

The Adopt-A-Stream Program has provided an opportunity for Kodak biologists to work with many students. The Benjamin Franklin High School students have profited by gaining valuable experience through working with chemicals, equipment and professional scientists to collect and analyze data. Kodak, like other potential employers, needs employees that have highly technical skills and an understanding of science. Our investment in these students today will increase their chance for success in a few years. Businesses need to be involved in schools (not as educators, but as mentors), particularly at the local level, to push for adequate preparation of students to meet society's needs. We can provide the role models that students need to make the decision to choose science as a career path, to thrive in an academic environment, and to achieve while in school.

Workshop Session II: Planning and Developing Successful Programs

TRAINING MONITORS

Presenters: Loren Kellogg, Izaak Walton League of America's Save Our Streams Program; and Tom Murdoch, Adopt A Stream Foundation.

Loren Kellogg

Izaak Walton League of America

THE IWLA APPROACH TO TRAINING

The Save Our Streams Program (SOS) of the Izaak Walton League uses a biological monitoring technique developed in 1983 by the Ohio Department of Natural Resources working in association with the League. The technique is based on the fact that different groups of stream macroinvertebrates (the critters that live in a stream) have different tolerances to pollution, which means they can serve as useful indicators of water quality. This monitoring technique rates a stream using the number of different types of stream organisms and their relative tolerance to pollution to determine stream health.

TRAINING VOLUNTEERS

The two main objectives of the SOS biological monitoring program are to give participants the knowledge, resources and support they need to help them effectively understand and address water-quality problems, and to increase the supply of credible information available on water quality. SOS volunteer training can be divided into four basic components which together work to support these objectives: initial training sessions, support networks, field spot checks and follow-up workshops.

Our initial training workshops generally last about four hours. Each participant is given their own SOS kit to look over before we begin. Workshops are broken down into three basic parts. First we have a slide show that lasts about one and a half hours. This slide show emphasizes a watershed (or drainage basin) approach to understanding water quality. We provide an education on point and nonpoint sources of pollution, how land uses relate to water quality, and ways to address the types of problems typically encountered. Also included in the slide show is an introduction to biological monitoring, macroinvertebrate identification, watershed mapping and siting monitoring locations. During this presentation we ask participants to listen closely without taking notes because the important information is contained in our SOS kit.

The next part of the workshop takes place out on the stream. For our sample site, we look for a riffle area. Although we do have an approved muddy bottom sampling technique, sampling in a riffle area is best because riffles provide similar environments between stream, with the optimum combination of high oxygen levels, good habitat, and an abundance of food for stream critters.

Using a kick-seine to trap the macroinvertebrates, we completely rub the rocks and thoroughly disturb the first few inches of stream bottom in a three-foot by three-foot-square area in front of the net. The organisms are trapped in the net and carried to the shore to be documented on the SOS survey form. At each sampling site, monitors take samples from three separate three-foot by three-foot-square areas in the riffle, starting from the farthest downstream location and moving upstream, or moving side to side across the stream so as to avoid any overlap. Results from each of these samples are recorded separately, and the sample with the highest index number is considered the best representative value for the site.

During the training session, we carefully identify

each organism we find by asking questions: How many tails does it have? Does it have antennae? Each volunteer receives a bug card to help with identification. The bug card is organized into three different groups of organisms. Group one organisms, such as the stonefly and the mayfly, are generally intolerant to pollution. They require good water quality and high levels of oxygen to do well, and are usually the first to go when problems occur. Group two taxa, such as damselfly and dragonfly nymphs, are more tolerant and are generally found in fair to good (or better) water quality conditions. Group three taxa are organisms, such as leeches and worms, that can often survive low oxygen levels and severely degraded water conditions. Group three organisms can be found in any quality of water. Your water isn't necessarily polluted if you find a leech or worm, but if you've got nothing else but worms in your sample your stream is probably in trouble. The better the stream quality, the more numerous and sensitive the groups you will find.

To make sure each participant can recognize the identifying characteristics, we go over the survey form in detail, highlighting not only how to answer the question but identifying the intent behind the question. Our survey is set up so that organisms are assigned a letter value (A = 1-9, B = 10-99, and C = 100+). We take the number of different types of organisms in each column and multiply it by a different number. A healthy stream supports a balanced population of organisms from each category, with an emphasis on organisms in the sensitive range. When you multiply the more sensitive organisms by a higher number, you receive a higher total index number for your survey. The higher the index number, the better the rating.

Information on these monitoring procedures are found in the SOS Stream Monitoring Instructions and SOS Stream Monitoring Guidelines. These documents also include information on identifying and adopting stream monitoring stations. For example, if you adopt more than one station, we recommend you choose strategic sites that are up and down stream from a tributary or discharge pipe. Also, each station should be monitored at least four, but no more than six times per year. The minimum commitment for our program is one year because at least one year of data is required to get a picture of stream health.

Safe monitoring is a very important part of our discussion. It is a good idea to wear boots and gloves, and wash carefully when you are done. We also encourage people to be environmentally responsible. This means don't leave anything you brought, and do what you can to minimize your impact on the stream. Because of our spot checks and bug tests, we don't need to preserve all our samples, so our monitors can return the critters to the stream.

The last part of the workshop involves an identification session, a question and answer period, and stream station sign up. During the identification session, we talk about support systems and available resources, such as SOS regional coordinators and reference materials. Then we play a little game called pass the bug.

Because of the amount of information covered in our initial workshops, we try to keep people interactive by asking lots of questions. This seems to keep participants on their toes and thinking, and it helps to highlight the important points to remember. For example, when we are about to jump into the stream to monitor, we ask what area are we looking to sample? What is a riffle? Why a riffle? And so on.

In our state programs, all training, supplies and equipment is provided free of charge and open to all concerned citizens. Each state-sponsored program is tailored to complement the resources and support capabilities available for volunteers in the respective state. For example, in West Virginia, State Soil Conservation Committee employees have been specially trained as regional coordinators for the SOS program. Regional SSCC offices are equipped with the full complement of SOS materials and supplies they need to conduct training sessions, answer questions for monitors, perform quality assurance/quality control (QA/QC) training checks, and respond to problem water quality reports with chemical testing equipment (supplied by IWLA).

Part of our QA/QC measures is to spot check 15 percent of our monitors. This is done by national

and regional staff, who schedule appointments to observe volunteers monitoring. At these sessions, we observe the whole process from riffle identification to finished survey results; then we offer suggestions to improve monitoring technique (if applicable) and make a written evaluation. These evaluations are included in our files and will be submitted regularly with our data. Also, anytime survey results are inconsistent (poor results in a known trout stream) or have problems (not in a riffle) or just have poor results, I call volunteers and ask them about it. If the problem seems to be due to monitor error, I or one of our coordinators make an appointment to monitor with the volunteer.

In addition, we have follow-up workshops (as detailed in our QA/QC guidelines) six months after our initial trainings. These workshops are designed to accomplish three things: address any questions monitors may have, no matter how bizarre; refresh participants on the resources of the program; and introduce them to other monitors in the area. It also gives us a chance to inform participants of any changes in the programs (biological monitoring is an evolving science).

We evaluate our monitors by organizing small groups and watching them stream monitor. This evaluation provides a quick check for potential problems and remind participants of issues they may have to discuss with us. Next is a formal test of macroinvertebrate identification skills. Monitors are allowed to use any materials they normally have in the field to identify test organisms from all the groups in our reference collection. These tests are scored and reports are used to evaluate the accuracy of data at each monitoring station.

The last part of our retraining session is an informal discussion. This gives monitors a chance to talk about what they found, what they are doing, or what they would like to do. Also we encourage everyone to exchange numbers and continue communicating with each other, so monitors can better band together to address problems they find. The end result is valuable water-quality information and a network of caring citizens armed with the knowledge and the resources to identify and respond to stream problems. This group of caring individuals actively work to protect and restore our precious rivers and streams.

Tom Murdoch

Adopt A Stream Foundation

THE ADOPT A STREAM EXPERIENCE

In 1990, the Adopt A Stream Foundation (AASF) began researching education and training materials related to conducting watershed inventories and monitoring physical, biological and chemical characteristics of streams. The intended product of this research is standardized watershed inventory and monitoring procedures for volunteer use throughout the Northwest and the nation. Major sponsors are the Washington State Department of Ecology, the EPA, and the Bullitt Foundation.

After sifting through many excellent publications from 39 states, in 1991 the AASF completed a working draft of *A Streamkeepers Field Guide, Watershed Inventory and Stream Monitoring Methods*. This publication takes the volunteer from the big picture, which includes an introduction to what a watershed is and how it functions, to conducting a watershed inventory to specific monitoring procedures at the micro level, including the tried and true analysis of hydrology, chemistry and macroinvertebrates. The guide currently is being field tested by 118 teachers and community groups.

While many of the monitoring procedures in the guide are familiar to the dedicated volunteer, improvements have been made in how to interpret the information. In addition, the book includes instructions on how to put inventory and monitoring information to use, initiating corrective actions and affecting social and political change. The guide is projected to be available by the 1992 Christmas season and will be distributed by the University of Washington Press and the AASF.

Along with developing an inventory and monitoring procedures manual, the AASF has developed a training program designed to keep the guide from

gathering dust on a shelf, and to get it wet and wrinkled (it rains a lot in the Northwest), along with its owner out in the field. For volunteers who are interested in becoming ecological observers, actual field training to complement written instructions is essential. On-the-job training not only builds confidence in the volunteer, but increases the confidence level in the quality of the data collected.

The AASF has the challenge of providing training to volunteer monitors throughout Washington state, which is a very diverse place. The state has rain forests (not all of them have been cut down), rapidly growing urban centers with SuperFund sites and traffic jams that rival Los Angeles, beautiful mountains, arid wide open plains, rivers with salmon, creeks that have caught on fire, abundant agriculture, ocean coast lines and the Puget Sound, as well as areas of small-town USA.

When becoming a certified Streamkeeper, volunteers have to think about a variety of issues, including availability of time; who else may be drafted into service; and collecting, storing and presenting data. Streamkeeper training provided by the AASF is limited to teachers or representatives of established community groups whose respective organizations have provided a written commitment to conduct a watershed inventory and monitor its condition on a monthly basis for a minimum of two years. In addition, these groups are required to share their information with the AASF, who will provide it to the EPA for inclusion into a national geographic information system.

Streamkeeper candidates must attend an all-day Adopt A Stream Workshop, and an all-day Streamkeeper Field Training Workshop. AASF divided the state into 12 regions covering three to four counties and scheduled workshops at central locations. The workshops, which are open to large audiences including Streamkeeper students, provide basic training on how to adopt a stream. Local experts from each region are introduced and invited to assist the AASF staff in taking the audience through the five steps of adopting a stream:

1. Find out all the information available about your watershed, including its history (the AASF usually has a Native American present this section), geology, hydrology, land uses, and fish and wildlife.
2. Identify human resources potentially available to assist you (friends, neighbors, schools, community groups and businesses) and share the work load.
3. Decide what you would like your watershed to be like next year, in five years and 25 years down the road.
4. Create a plan by identifying and scheduling actions necessary to achieve your goals.
5. Become a Streamkeeper and carry out planned actions, monitor results and adjust goals.

For more information on this process, see *Adopting a Stream, a Northwest Handbook*, Steve Yates, University of Washington Press, 1989; $9.95 plus $2 postage and handling from the AASF, P.O. Box 5558, Everett, WA 98206.

In addition to learning the basics of adopting a stream and getting to meet local resource managers, these workshops provide Streamkeepers with an opportunity to network with one another and recruit from participants who just came to see what was going on.

The Streamkeepers then must complete an all-day field training session that provides training on inventory and monitoring procedures in the guide. Streamkeeper field training classes are small, with no more than 20 students. Three AASF staff, complemented by experts from local resource management agencies, provide students with direction on gathering watershed information and the steps involved in preparing a baseline watershed inventory.

Under AASF supervision, Streamkeeper students practice mapping stream reaches and recording observations at a good site, an area that is in relatively good ecological order. The process is repeated at a bad site, an area that has been disturbed by human-induced causes. This contrast enables the neophyte to see the way things ought to be and what they look like when the ecological system is out of order. The students also practice all of the monitoring procedures in the guide at both locations. At the end of the field training session, students present their data and compare findings at the two sites.

Streamkeepers who successfully complete the two workshops are then expected to organize members of their groups to initiate the research phase of their inventory and monitoring activities. Their next assignment is to set up field training schedules for their groups. We have found that of the 118 Streamkeepers trained between June and August 1991, many have been able to progress from the initial training to some remarkable projects.

At Edmonds Woodway High School, an advanced biology class and its teacher, Ginny Burger, adopted a small stream that flows into Puget Sound. Ginny provided her students with training she learned at the Streamkeeper workshop. Their adopted stream flows exclusively through backyards in a suburban neighborhood. Students contacted all property owners and requested permission to monitor the stream. Teams of two or three students then inventoried and monitored the conditions of the stream within each backyard. Their observations were provided to each property owner with recommendations, such as reduce lawn fertilization and plant native vegetation along streambanks.

After attending a workshop, Western Washington University student Brad Vinish organized local middle and high school students to inventory and monitor a small stream in Blaine, Washington. The volunteers discovered that several stream reaches are underground and that the majority of the local residents don't recognize the potential value of this abused natural resource. The Blaine Stream Team is in the process of completing a baseline inventory of the stream and setting up monitoring stations to record its physical, biological and chemical characteristics. They have also approached the Blaine City Council and initiated actions to have the stream formally named - to the delight of many and the displeasure of some, who think their development potential will be limited if the stream becomes better habitat for fish.

During the course of their watershed inventory, Wenatchee Streamkeepers found that every storm drain in the city led directly to the Wenatchee River. In addition to monitoring the impacts, these Streamkeepers have launched a campaign to mark each storm drain with a sign that reads "dump no waste, drains to stream." Students from the Wenatchee High School collect data and do the painting.

The majority of the Streamkeepers will likely require secondary field training assistance with their groups. Organizations like the Izaak Walton League and the Chesapeake Bay Foundation recommend that secondary training be provided within six months of the preliminary training. This training should be in the form of a field test that is similar conceptually to a check ride required for a pilot to maintain currency to fly an airplane.

A field test will enable the Streamkeeper to demonstrate inventory and monitoring procedures and determine if they are consistent with standardized practices. This process reinforces the confidence of the individuals who are doing it correctly and provides an opportunity to correct any deficiencies that are noted.

The AASF provides all Streamkeeper graduates with a roster of other Streamkeepers and encourages them to exchange information. Streamkeepers are also encouraged to contact AASF staff to discuss any difficulties they are experiencing. The AASF provides Streamkeepers with information on any new relevant inventory or monitoring information. In addition, Streamkeepers complete status report questionnaires within three months of their initial training.

To help nurture the Streamkeepers and encourage their long-term involvement, a Streamkeeper Summit is organized once a year to recognize the achievements of the Streamkeepers and demonstrate state-of-the-art inventory and monitoring techniques. Motivational presentations on putting monitoring information to use are also provided.

INTEGRATED MONITORING SYSTEMS

*Presenters: John Kopec, Ohio Department of Natural Resources; Stuart Lehman, Maryland Department of Natural Resources; and Virginia Lee, University of Rhode Island.**

John Kopec

Ohio Department of Natural Resources

THE ADVANTAGES OF INTEGRATING VARIOUS MONITORING PROGRAMS

Regardless of whether citizen volunteers monitor streams, lakes, ponds, estuaries or wetlands, they are gauging the health or condition of only one element of a larger ecosystem, the watershed.

Citizen monitoring programs offer excellent opportunities for the average citizen, young or old, to learn about biological principles of aquatic environments and the ecology of fresh and saltwater ecosystems. Especially important is the chance for volunteers to gain a comprehensive knowledge, through hands-on experience, of how the biological integrity of a stream or lake is dependent upon land-use practices within the watershed. Although much has been written about the effects of point and nonpoint pollution upon our aquatic environment, nothing has a more dramatic impact than seeing it for oneself, reflected in the observations of chemical analyses, benthic health or physical impacts.

Currently, most monitoring programs in the country deal with one particular water resource, rivers or lakes for instance, and many have traditionally limited their focus to one of three evaluation procedures: chemical, biological or physical. Lately, however, a number of programs have begun to expand, combining evaluation procedures as well as adding the monitoring of additional resources. Programs are beginning to see the immense value of providing their volunteers with a more comprehensive picture of stream or lake conditions through the expansion of monitoring parameters. As many programs monitor additional water resources, volunteers become much more "watershed informed."

Since the majority of monitoring programs rely on simplicity, volunteers often become bored after several seasons, especially if they are confined to a particular station where the results may change little, if at all. The opportunity to add a procedure or monitoring regimen often spells the difference between whether a program loses seasoned volunteers or retains them at a more active level, and in a greater capacity.

This increase in monitoring opportunity and sophistication also parallels many volunteers' hunger to learn more about the resource in which they are involved. A number of programs have experienced a change in volunteer attitude. Many citizens who joined the monitoring work force for reasons ranging from fulfilling a need for outdoor education (teachers, youth group leaders) to looking for a fun outdoor activity, soon evolve into environmental activists who want greater responsibility and involvement.

One note of caution, however, must be mentioned. Citizen monitoring programs can be very effective in revealing general information about a water resource, but often fall short on providing the level of sophistication necessary to determine specifics regarding certain pollutants affecting waterways and especially the precise location of nonpoint

**Transcript Unavailable*

pollution problem areas. Professional investigators using state-of-the-art techniques and equipment have difficulty in this area themselves. Given these limitations, it is even more difficult to link observations between various monitoring regimens within a watershed. For example, chemical analyses of a waterway upstream from a lake may not relate in any logical way with similar analyses performed in the lake itself. Likewise, data derived from biological evaluations, while revealing a good picture of the aquatic health of a stream or lake, may not coincide as expected with chemical readings that indicate a somewhat different picture. These apparent anomalies should be explained to volunteers whose involvement with combined monitoring programs will likely develop some pertinent questions.

Combining existing monitoring programs can dramatically increase the number of volunteers for each separate program. Many volunteers who are trained and active in monitoring a lake, for instance, become eager to expand their involvement and gain new experiences by becoming involved with programs that deal with the entire lake watershed. If increasing interest levels are successfully met with program expansion, the end result is often volunteers who are willing to accept a greater responsibility in citizen monitoring programs. Developing a cadre of volunteers who are willing to serve in an administrative fashion training other volunteers, distributing and collecting equipment, or assisting with data entry and evaluation can be vital to citizen monitoring programs. Just as we have witnessed the phenomenal growth of citizen monitoring in the last decade, we have also grown well aware that many programs still operate on a shoestring budget, with only a few people who oversee a huge army of volunteers that grow with every season. Most would agree, given the bleak prospect of appropriate budgets, that volunteers themselves must assist in some of the administrative tasks.

The likelihood for financial assistance from foundations, corporations or government may be enhanced for programs that integrate additional monitoring regimens, as this approach seems more likely to give volunteers a broader educational experience and more comprehensive role in environmental management and protection.

Stuart Lehman

Maryland Department of Natural Resources

CITIZEN MONITORING IN THE MARYLAND TARGETED WATERSHED PROJECT

The Targeted Watershed Project is a multi-agency, state initiative to improve water quality and restore living resources in several key tributaries to the Chesapeake Bay. An important component of the project is the volunteer monitoring activity which is part of a comprehensive biological and water-quality monitoring program. The purpose of Maryland's larger monitoring program is to guide planning and measure the progress of habitat restoration and pollution control programs.

The watersheds targeted by this project are the Piney and Alloway Creek watershed in Carroll County, Sawmill Creek in Anne Arundel County, Bird River in Baltimore County, and the German Branch watershed in Queen Anne's County. The targeted watersheds are all stream basins which are either threatened by degradation from urbanization or contribute a disproportionately high level of nutrients to the bay from agricultural nonpoint sources.

In addition to the volunteers, the project has recruited participants from over 40 state, federal, and county agencies to play key roles in the monitoring, communication and implementation phases of the project. Citizen water-quality monitoring is conducted by approximately 25 volunteers, and data is now analyzed by state agencies and integrated into annual water quality reports.

COMBINING CITIZEN MONITORING WITH THE MARYLAND STATE PROGRAM

Citizen data is collected for seven parameters including air temperature, water temperature, dissolved oxygen (DO), pH, turbidity, and weekly

rainfall. The sampling procedures, training program and quality assurance (QA) methods were standardized by the pioneering work of the Alliance for the Chesapeake Bay (ACB). ACB has acted as the overall coordinator of the monitoring program for the state. Most of the equipment is purchased from the LaMotte Company in Chestertown, Maryland. This includes test kits for DO, pH and turbidity, as well as thermometers and rain gauges.

Volunteer monitoring provides additional data to the state's monitoring program as well as stand-alone trend monitoring data of use to citizens studying and getting involved in restoration actions in their watersheds.

The overall state monitoring program includes a biological component; benthic macroinvertebrates are sampled by the Maryland Department of the Environment (MDE), and fish collections are made by the Maryland Department of Natural Resources (DNR). The water quality (chemistry and nutrients) measurements and sample collection are done jointly by DNR and MDE, using contracting laboratories for the analytical lab work. Flow measurements are made by the U.S. Geological Survey and occasionally by DNR biologists. Weather data is collected by the National Weather Service and its network of volunteer observers around the state. The streams are also rated on their habitat suitability during the biological surveys using the method proposed in the *Rapid Bioassessment Protocols* published by the U.S. EPA (Plafkin et.al., 1989).

Volunteer monitoring is conducted weekly throughout the course of the year. Samples may include storms or baseflow measurements because they are generally taken at the same time of day, on the same day, each week. This routine collection over the course of several years will help achieve a certain degree of randomness regarding stream stage. This schedule helps assure that data will be collected during a wide range of flows and makes the data more useful in determining future trends.

The data also has current uses. Because state biologists take only monthly samples, volunteer data allows the agencies to fill in the gaps of the water quality record for several parameters between routine sampling visits. This allows the targeting project to have better coverage of episodic problems such as pollutant spills or algal blooms. For instance, the level of dissolved oxygen in one of the targeted streams fell to a level below state criterion during a period of overlap between state and volunteer monitors. Based on this finding, state monitoring staff recommend that some stations be monitored more frequently to determine if there are any potential aquatic life impacts.

MEETING NEW CHALLENGES

The Targeted Watershed Project must streamline in response to statewide budget cuts. The project could not afford to continue to have a contractor manage the volunteers. Instead, it is trying to shift some of this responsibility to the monitors. ACB staff will still be available for training and assistance with quality control, and state biologists will be available to assist with technical problems and data interpretation.

Fortunately, several willing volunteers have agreed to assist with monitoring management. Among other things, these new monitoring coordinators in each of the targeted watersheds will be asked to set up times and places for meetings to conduct QA procedures, exchange information and learn about restoration progress in the watersheds. The coordinators will be asked to try out some new computer software to analyze their own data for each watershed instead of sending it to state agencies.

In the long run, some major benefits should arise from this change. The new program may help foster better communication between the monitors and state water-quality scientists. Managing their own data will allow more timely comparisons between water-quality measurements and changes appearing in the streams. Finally, the hard work of routine monitoring may become more fun as monitors learn to work more as a team.

REFERENCE

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

SETTING UP DATA SHARING PROJECTS WITH STATE AND LOCAL GOVERNMENTS

Presenters: Abby Markowitz, Maryland Save Our Streams; and Karen Firehock, Izaak Walton League of America.

Abby Markowitz

Maryland Save Our Streams

MARYLAND'S SOS EXPERIENCE

Maryland was the first SOS project under the Izaak Walton League. In 1970, Maryland SOS became an independent statewide nonprofit organization committed to the protection and restoration of Maryland's more than 17,000 miles of flowing waters. Our overlying strategy is community organizing and leadership development for the purpose of building and nurturing educated and active citizen constituencies for neighborhood waterways.

Before I get into a discussion of initiating and maintaining cooperative and mutually beneficial efforts with state and local governments, I'd like to give you a brief history of Maryland SOS experience with government partnerships. Since it's inception, SOS has worked in partnership with both state and local governments. These partnerships have often taken the form of government contracts that provide SOS with the resources to develop and implement volunteer education, stewardship and monitoring projects in specific jurisdictions and watersheds.

For many years, SOS was a line item in the Maryland Department of Natural Resources' (DNR) budget. In 1987, SOS, DNR, Baltimore city and county joined together to create the Gwynns Falls Restoration Campaign. The campaign was an opportunity to use SOS to restore the water quality in an entire watershed with the ultimate goal of bringing the stream to a fishable and swimmable condition. The project brought together trained volunteers, community associations, local businesses and watershed residents, along with city, county and state government. Due to the initial success of the Gwynns Falls project, in 1989 SOS joined in partnership with two county governments to implement other projects based on the Gwynns Falls model.

The Baltimore County Citizens for Stream Restoration Campaign expanded the Gwynns Falls program to include the entire county, which contains nearly 2,000 miles of streams, creeks and rivers that flow into the Chesapeake Bay. The Severn River Project is a joint project with Anne Arundel County. The Severn is a state-designated scenic river with a watershed of about 70 square miles that includes the city of Annapolis.

In addition to county projects, 1989 saw the formalization of the SOS Adopt-A-Stream (AAS) program as a joint venture with the DNR in conjunction with the Governor's One Million Marylander's for the Bay. AAS is a statewide stewardship program that encourages active citizen involvement in monitoring the state's waterways and participation in activities designed to enhance appreciation of these waterways. Through AAS, the Gwynns Falls model was packaged to train individuals and groups without a great deal of staff support. To date, more than 8,000 miles of streams, creeks, rivers and the bay have been adopted by Maryland citizens. AAS monitoring projects include biological water monitoring, construction site monitoring, stream surveys and watershed surveys.

Volunteer data collected from these activities are forwarded to DNR, the Maryland Department of the Environment (MDE) and appropriate county

departments so that these agencies can incorporate the data into reports, direct their resources to more intensive study and rectify problems. SOS volunteers serve as the eyes and ears of understaffed government agencies, and all volunteer data forms, training materials and field supplies have gone through technical review by state and county agencies.

Now that you've heard the nutshell version of our project experience with government partners, I'd like to use the rest of my time to address three basic questions: How can government agencies and volunteers establish cooperative projects to share data and resources? What's in it for the volunteer group? What's in it for the government?

Perhaps the first thing to consider is self-interest. Any successful project must serve the self-interest of both the volunteers and the targeted government agency(s). Any answers you come up with that are true for both the government agency and your organization are a good place to start. Here are some examples of mutual self-interest that we have identified:

PUBLIC EDUCATION AND STEWARDSHIP

Both government agencies and volunteer groups committed to environmental protection, pollution prevention and/or resource management are interested in public education and community stewardship. Any group approaching an agency to initiate a joint effort would be well-served to promote education and stewardship as one of its primary goals.

Warm bodies in the water are also important. Agencies love to be associated with projects that get people in the field. Before beginning initial discussions with an agency, hold organizational meetings to gain support and promote your project from within. Many small groups SOS has worked with have initiated simple projects like tree planting or stream cleanups before embarking on a more sophisticated monitoring project. A history of successful recruitment and ongoing involvement will help make your case with the government.

GOVERNMENTAL DATA NEEDS

Another factor in establishing a cooperative monitoring project is deciding just what kind of volunteer monitoring you want to embark on. A little research will tell you what kind of data your local or state government might need. Also, target your agency. Which agency(s) needs the kind of data you can provide? Many people, including agency personnel, have a narrow definition of volunteer monitoring that is limited to instream chemical or biological monitoring. Through Adopt-A-Stream, we have worked to broaden that definition to include watershed, stream and construction site surveys. Through these projects, volunteers collect data that governments may need immediately.

For example, last year the Severn River Project sponsored the Great Severn Stream Survey. More than 200 volunteers walked, boated and canoed sections of the river and its tributaries. One of the tasks volunteers completed was to record and measure pipe outfalls. This information was requested by Anne Arundel County to comply with their National Pollutant Discharge Elimination System requirements. As follow-up, the county is working with volunteers to correct problems identified during the initial survey.

Sediment and erosion control is perhaps the most obvious example of immediate gratification for both volunteers and government personnel. Whoever is in charge of enforcement for your community would probably be thrilled to work with volunteers to monitor construction sites and report potential violations. Sediment personnel are notoriously understaffed, yet they are charged with keeping mud from hundreds or thousands of sites stabilized. In Baltimore County, we held Mud-Buster workshops in the fall of 1991 that were facilitated by SOS staff, community leaders, government personnel and developers. An ongoing construction site inventory of a watershed is a wonderful monitoring project.

COST-EFFECTIVENESS AND EFFICIENCY

Money, money, no one seems to have any. Agencies love to hear how cost-effective and efficient your program will be, especially if you are asking them for funding. Find tangible ways to measure cost efficiency. For example, find out how

much it would cost for an agency to hire enough personnel to adequately monitor all construction sites within their jurisdiction. Then figure out how much less it will cost for a core of volunteers to do the initial monitoring and screening. Contact consulting firms to discover how much they would charge for comparable services. Through this type of research, we discovered that what volunteers can accomplish for about $40,000 per year would cost a consulting firm over $400,000 - without the community education aspect. When working with financially strapped agencies, be creative in terms of the type of resources those agencies might initially provide. Maybe they can offer in-kind services, training facilities and materials. After a program has a proven record, funding may be easier to obtain. Also, use your agency partners to help identify alternative sources of funding.

WHITE HATS ALL AROUND

Everyone likes to wear the white hats and be the good guys. Government agencies often suffer from a bad reputation, frequently undeserved. Community education should focus on educating citizens to their responsibilities with regard to environmental protection. A cooperative effort will go a long way toward alleviating the tension that often exists between the government and the community. A volunteer monitoring project can often serve a necessary liaison role between government and citizens. Also, don't ignore your elected officials. They like to interact with constituents and can be great allies in building partnerships with the agencies they administer.

How can we convince skeptical government agencies to use volunteer-collected data? The best way to convince an agency is to involve them in the process from the very beginning! Whatever kind of monitoring you decide to undertake, an agency is far more likely to view the data as credible if they have been involved in developing and implementing the project. That way they don't have to take your word for it that the data is accurate. They will have been partly responsible for making sure that it is accurate and credible. Further, involve the agency in the decision-making process of what type of monitoring project to establish, which refers back to data needs.

Government personnel, with the appropriate expertise, should be invited to serve on any steering and technical committees involved in overseeing quality assurance and quality control. Also, government personnel should be invited to participate in the actual monitoring so they see first-hand how the procedures are carried out.

Don't promise more than you can deliver! If you are overly ambitious, especially at first, you may be inviting skepticism. Set reasonable short- and long-term goals and be flexible enough to alter those goals if necessary.

Use volunteer leadership to the fullest. If your organization has paid staff, make certain that you develop volunteer leaders and that those leaders develop relationships with potential government partners. People tend to be less skeptical of those with whom they have an honest relationship.

How do we meet government standards for data, feedback, quality control and applications? Perhaps our best illustration of dealing with these factors on an ongoing basis is the 100 Points of Stream Monitoring in Baltimore County. Prior to implementing this program, Baltimore County's Department of Environmental Education and Resource Management (DEPRM) was involved in all aspects of determining data standards, quality control and applications. Additionally, we sought the expertise of MDE and DNR in developing volunteer procedures. Government standards were met because the government had a hand in determining the methodology and techniques. Representatives from DEPRM, MDE and DNR are all members of the 100 Points Technical Advisory Committee. Part of their charge is determining what level of data to reasonably expect from a volunteer program with limited resources and to fashion QA/QC mechanisms accordingly.

Start slow and set achievable goals in these regards. When the 100 Points first began we envisioned our primary goals as education and stewardship. Within the first year, working closely with

state and local agencies, we realized that we could in fact produce very specific data that met government standards and surpassed our expectations. Accordingly, we began to adjust our standards.

If possible, compare your data with that collected by professionals. One of our criteria for the 100 Points was to deliberately select some sites that the state was also monitoring. In this way we could compare volunteer and professional data using basically the same assessment procedures. We found that there was good agreement between these data sets. Certainly, one reason for this was the hands-on involvement of our government partners in the entire process.

I'd like to end by reiterating the SOS philosophy: Truly protecting and restoring our water resources requires the commitment of both citizens and government in innovative, ongoing and cooperative efforts.

Karen Firehock

Izaak Walton League of America

USING VOLUNTEERS FOR STATEWIDE NETWORKS

The Izaak Walton League of America's (IWLA) Save Our Streams (SOS) program has trained volunteers in biological water-quality monitoring techniques since the early 1970s. The first SOS program began in Maryland in the 1970s and was the brainchild of IWLA board member Malcolm King who worked for the Maryland Department of Natural Resources (DNR). King organized the project with Maryland League chapters and convinced the DNR to create a staff position to coordinate the project. Eventually, the Maryland SOS project became so successful that it separated from the state and became its own nonprofit organization called Maryland Save Our Streams.

Meanwhile, the League's national office saw that the Maryland project was a great idea and decided that permanent statewide networks were needed to run in cooperation with state agencies. The IWLA believed volunteer monitoring programs were critical to help states gather needed data and to help volunteers be effective in monitoring water quality and addressing pollution problems.

In the early 1980s, the League formed a partnership with the Ohio Department of Natural Resources (ODNR) to train volunteers to collect biological monitoring data on the state's 10 scenic rivers. Working in cooperation with ODNR, the League's biological monitoring method was modified to be more scientifically valid, easier for volunteers to use, and to provide data usable in state monitoring programs. Using this first partnership as a model, the League created a statewide network in Virginia in 1988, a statewide network in West Virginia in 1989 and a statewide network in Tennessee in 1990.

These partnerships are all organized differently depending on the unique needs of each state. All programs follow quality control and quality assurance plans approved by the Environmental Protection Agency (EPA) and provide credible data that have a variety of uses for states and volunteers. These states serve as models for the League to use in advising other states and have also given the League a chance to learn what works and what does not. Hopefully, sharing our experiences will help you avoid some of our pitfalls and begin with a successful program to share data, resources and energy.

Your first step, before determining monitoring methods or data-sharing procedures, will be to convince the state that it needs a volunteer monitoring program. In these recessionary times this may seem difficult, since many states are now in the process of cutting or already have dramatically cut state budgets for monitoring and enforcement. However, this is really an argument for having a volunteer monitoring program! Volunteer monitoring can vastly expand a state's ability to monitor and protect a water resource.

For example, the Division of Natural Resources in West Virginia uses a $30,000 grant from EPA 319 monies (allocated to states for management of nonpoint

source pollution) to help fund the League's SOS monitoring program in the state. An additional $25,000 is raised through grants from the League. The League augments the state's 41 monitoring stations for its 29,000 miles of rivers and streams by providing an additional 85 stations, giving the state a total of 126 stations with more volunteer stations to be added this spring. As you can see, for $30,000 the state gets a good data collection program with analysis and collection by the League, broad-scale public education on water quality, new publications and restoration projects. This certainly is more than the state could buy for $30,000 without the help of the League and hundreds of dedicated volunteers.

Before you make your case to the state or to other agency personnel, do your homework. Research how many monitoring stations the state maintains, what percentage of rivers, lakes or other waters are monitored and the frequency of monitoring. Review a copy of the state's nonpoint source pollution assessment and management plans, which all states were required to complete in 1989, and find out which rivers or water bodies have been designated as priorities by the state either because they are now polluted or threatened, or particularly unique or pristine and in need of monitoring and protection. Also find out how many permitted dischargers there are in the state and how the state oversees their discharge permits. The state may not have adequate enforcement personnel and may need help watchdogging industry.

For example, Ken Cooke who coordinates Kentucky Water Watch for the DNR, helps teams of volunteers adopt-a-discharger, an idea I first saw proposed by Maryland Save Our Streams. Kentucky Watch sets up the monitoring teams with copies of the industry discharge permit, chemical water monitoring kits and information on how to spot violations and assist with law enforcement.

Once you are ready to jump into your monitoring project, your first battle may be convincing the skeptics that volunteers can provide credible data. If you are part of an environmental organization or school, your skeptics may be state agency personnel. If you are a state agency employee, you may be facing skepticism from within your own organization or from other agencies within your county or state. You first will have to convince these people that volunteers can provide credible data. If your state does not already have a volunteer monitoring program that provides data, you can use examples from other states.

Kentucky, West Virginia, Maryland and Tennessee use volunteer-collected data. Have skeptics contact these states to ask questions; supply skeptics with documents from projects, such as copies of monitoring methodologies and copies of the EPA-approved Quality Assurance/Quality Control (QA/QC) documents. SOS often has a state agency skeptic speak to another agency person in a state that is accepting our data. We also have them speak to staff at regional and U.S. EPA offices, who assure them volunteers can collect credible data, and we get states to write letters of support stating that we provide good, sound scientific data. There are also numerous publications you can share with the state, such as the EPA *State Managers Guide to Working With Volunteers* or the EPA volunteer monitoring newsletter, *The Volunteer Monitor.*

The first step in setting up a data-sharing project with a state government is to make sure the data your group has decided to collect — chemical, biological, habitat quality or other data — is needed by the state and is in an acceptable and usable format. An informal meeting should be held with state monitoring personnel to determine their data needs. You then can offer to collect data for them and discuss its format. The goals of your data-sharing program are also important at this point. For example, does the state need data for enforcement purposes or to determine if a river needs further monitoring, long-term trend analyses or red flag raising? If the state wants to use data for enforcement, its collection probably will have to be rigorously controlled, with many quality control checks. If data are used only for monitoring long-term trends or alerting the state to potential problems, monitoring requirements may not be as stringent.

Once all parties agree to begin data sharing, and necessary funding has been secured, the next step is

to develop a QA/QC document. This is a detailed plan that explains how the project assures that volunteers are properly trained and can provide credible data. A good plan provides for periodic retraining, result checking and review, and comparison with state methods. The plan should be developed in cooperation with state agency personnel; it should not promise to do more than is feasible by the volunteers and it should be sent to the regional EPA for review and approval.

Who will collect the data and how will they organize it are also critical questions to consider. It may be best for the state to receive volunteer-collected data and provide technical review. The IWLA receives data from its three model states, reviews it, addresses any problems, enters it on a computer and submits computer disks to appropriate state agencies on a quarterly basis. State agency personnel then comment on any problems they notice, conduct additional monitoring or inspection of any problem stations and investigate pollution problems. Our staff helps volunteers address problems as soon as they are discovered, rather than waiting for state agency personnel to review and analyze data. However, if a group relies primarily on volunteers, it is advisable to have the state input and analyze collected data.

End uses of the data are among the most important considerations. Volunteers will drop out of a program quickly if they feel their data are not being used. Volunteers need immediate feedback if there are problems. They should have access to technical help either by phone, in person or at retraining sessions, and most importantly, they should feel appreciated. For instance, in addition to periodic QA/QC retraining meetings, the League has a hotline (800-BUG-IWLA) our monitors can call with biological monitoring questions. It is important to thank your volunteers through awards, receptions, formal recognition in state reports, articles in state wildlife magazines and other avenues. Volunteers will want to see their data used through sections in state reports, updates to the state's nonpoint source pollution assessment and other documents.

Finally, it is important to build in long-term plans for your project and ensure periodic review to determine if the program is on the right track. For example, the League has changed its survey forms, instructions, macroinvertebrate identification cards and many other publications throughout the years, as methods and new techniques were perfected. We also are adding new reports, such as an annual monitoring report, written for use by volunteers, to present to county planning agencies, media, scientists, schools and others who need easy access to data results. It is important not to let your program grow too large. For example, due to time constraints we have capped our Virginia program at 225 biological monitoring stations. We want to ensure we can do a good job managing our current network before expanding.

MAKE IT YOURSELF

Presenters: Anne E. Lyon, Tennessee Valley Authority; and Carolyn Betz, Wisconsin Department of Natural Resources.

Anne E. Lyon

Tennessee Valley Authority

MONITORING USING HOMEMADE EQUIPMENT

In 1986, the Tennessee Valley Authority (TVA) created the Teacher/Student Water Quality Monitoring Network. The primary goal of the program was to gather basic water quality data from small streams and lakes in the Tennessee Valley that TVA personnel were unable to monitor. When the program was initially designed, we focused it primarily on water chemistry and use of water test kits. Soon after we began the program, many teachers and students expressed interest in collecting biological data, so we added this component to our program and expanded our network to include biology teachers.

Our first workshops taught teachers and students to use a wide range of professional sampling equipment including Surber samplers, D-nets, kick nets, and seines. It quickly became clear, however, that professional equipment was beyond the reach of most school budgets. It also became apparent that we needed printed information on how and where to properly use the different pieces of equipment. The result was the development of the first two booklets in TVA's Water Quality Series — *Water Quality Sampling Equipment* and *Homemade Sampling Equipment.*

These two booklets were designed to work as a set. Booklet one, *Water Quality Sampling Equipment,* contains information on how and where to use professional sampling equipment, and booklet two, *Homemade Sampling Equipment,* contains directions on how to make a low-cost facsimile of all the equipment listed in booklet one. Both booklets are organized the same way. Each contains sections on water quality sampling equipment, invertebrate and plankton sampling equipment, artificial substrate samplers, fish sampling equipment and additional information. Booklet one also contains information about field sampling supplies, laboratory supplies and equipment, and field attire. Booklet two also includes a section on sampling supplies.

Each item in both books contains an italicized description of what the equipment is used for. For example, the Meyer Water Bottle in booklet one is "for collecting a water sample at a desired depth." In booklet two, the facsimile-the Deep Water Sampler, has the same italicized description. To determine which piece of homemade equipment corresponds to the professional type, match these italicized descriptions. The equipment names are not the same.

Equipment described in booklet one is broken down into the following categories: description, where, how, limitations and safety. Each entry is accompanied by an illustration and a descriptions of what each piece of equipment looks like and how it is constructed. For example, the D-net description reads "consists of a canvas reinforced nylon net on a D-shaped wire frame attached by a metal clamp to a three- to four-foot wooden or metal handle." The "where" section describes what type of habitat is appropriate for use of the piece of equipment. For example, D-nets are typically used in "streams or reservoirs with a strong current." The "how" portion is perhaps the most critical section because it

describes in detail how to correctly obtain a sample using that piece of equipment and how to store the sample. The "safety" section includes guidelines persons should take when sampling with this piece of equipment. For example, when you use a D-net you need to wear gloves to protect your hands from broken glass and other sharp objects, and sturdy shoes to keep your balance on potentially slippery rocks. The "limitations" section was included primarily to describe where use of the equipment would be inappropriate and to alert the user of potential problems.

Booklet one contains sections on field sampling supplies, laboratory supplies and equipment and field attire. These sections contain illustrations of commonly used supplies and a description of what they are used for. For example, a cooler is "used for cooling and preserving water samples and live fish." The field attire section contains useful information on how to dress for field work and why.

The additional information section in booklet one is broken down into general, aquatic plants and animals, limnology, water quality, supplies and equipment. The general portion lists general references for teachers and citizens on how to investigate water quality problems. The aquatic plants and animals portion contains citations for useful reference guides to aquatic plants, invertebrates and fish. The limnology and water quality portion contains common reference books used by professionals in the field. The last portion, supplies and equipment, contains the addresses and phone numbers of supply stores which carry professional sampling equipment and supplies.

Booklet two is organized quite differently. Each entry contains a materials list, directions and illustrations. The materials lists contains all the materials including tools that will be required to make the piece of equipment. The directions are divided into individual steps. An illustration or combination of illustrations is included with each entry to show how the piece is built and what it looks like when it is finished.

The additional information section of booklet two is rather short and references other sources which contain homemade sampling equipment instructions.

These two booklets were printed in October 1988. In the past three and a half years, TVA has printed and distributed more than 25,000 copies of both booklets. We have also given groups outside the Tennessee Valley the right to reprint our guides for use in their water quality education programs. To secure permission to reprint the booklets or portions of the booklets, TVA requires a letter. The letter should include: 1) whether you would like to reprint whole booklet(s) or portions; 2) how the reprint is going to be used; 3) how many copies will be printed; and 4) the requester's name, address and phone number. TVA will respond with a letter of permission and copies of the booklets suitable for duplication. Send this letter to: Environmental Education Section, Tennessee Valley Authority, Forestry Building, Norris, TN 37828; 615-632-1599. If you wish to obtain a set (one each) of the two booklets, write or call: Water Quality Library, Tennessee Valley Authority, 311 Broad Street, Chattanooga, TN 37402; 615-751-7338.

Carolyn Rumery Betz

Wisconsin Department of Natural Resources

written with Jeff Schloss, University of New Hampshire

CENT-SAVING SAMPLERS, SECCHIS AND SCOPES

Sampling equipment can be made to suit your program's needs at a fraction of the cost of commercially available products. The following ideas represent only a few of the many pieces of equipment that some of the volunteer programs around the country have designed, adopted and used for more than 10 years.

MEYER BOTTLE

If your program is interested in collecting water samples that will not be analyzed for dissolved gasses,

a modified Meyer bottle may serve the purpose. The New Hampshire Lakes Lay Monitoring Program developed one using a wine bottle housed inside a coffee can that is filled partly with cement. The bottle is stoppered and lowered to the desired depth. A sharp tug on the cord releases the rubber stopper allowing water from that depth to enter the bottle. Once full, the sampler is hauled to the surface where the water can be analyzed for parameters such as temperature, nutrients or plankton. For more information, contact Jeff Schloss at 603- 862-3848.

VERTICAL SAMPLER

In some instances, it is necessary to collect a column of water to analyze for nutrients or chlorophyll. New Hampshire again puts forth the design for this using a weighted garden hose; Vermont uses a similar tool. The volunteer lowers the weighted end of the hose into the water and when it reaches proper depth, crimps the hose closed. The hose is then hauled to the surface and emptied into a bucket or other storage container. For more information, contact Jeff Schloss.

WISCONSIN SELF-HELP WATER SAMPLER

One of the most challenging components of a lake monitoring program is being able to collect a water sample from depth. The Wisconsin Self-Help Water Sampler was designed by volunteer Paul Anderson to be used primarily for the collection of dissolved oxygen or other gasses. The sampler is made from an ordinary wide-mouth mason jar filled part-way with concrete mixed with sand; the concrete is then coated with a waterproof sealer. The jar weighs about two pounds, 12 ounces. The outside of the jar is wrapped with duct tape for added protection, to make it less slippery when wet, and to keep the pieces together in case of accidental breakage.

A wooden block sealed to the top of the jar lid provides support for the water-in tube, the lowering rope, and the air-out tube. The water-in and air-out tubes are made from the outer casings of round BIC™ pens; the tube stoppers are made from the plastic plug in the end of the pens. A small hole is drilled through the plug, into which a dacron planer board line is inserted. A knot is tied in the end of the cord which is then pulled back inside the plug. The inside of the plug is then filled with GOOP™ or other waterproof sealer.

Low-stretch multifilament polypropylene rope (6/32 inch diameter) is used to lower the water sampler. Two wooden reels are made for the sampler: one to keep the stopper cord and one for the lowering rope. The lowering rope is marked with an oil-based paint only at those depths at which a sample is to be taken. An orange mark shows the nine foot depth, and a red mark shows the 30 foot depth. It is easier for two volunteers to operate the sampler to avoid tangling the various ropes, although it can be operated by one person with practice.

To use the Wisconsin Self-Help Water Sampler, a 60-ml. sample bottle is placed inside the sampler so that the water-in tube is inside the sample bottle. The jar lid is screwed on, and with both tubes stoppered, the jar is lowered to depth. A sharp tug on the stopper cord removes the two stoppers, allowing water to enter the water-in tube and forcing the air that was in the jar out the air-out tube. This method of filling results in the sample bottle being overflowed more than five volumes before the final sample is collected. Air bubbles rising to the surface indicate to the volunteer that the stoppers were removed properly. To insure that the sampler has filled completely, wait for the air bubbles to stop before retrieving the sampler.

The sampler can be used to collect nutrient or chlorophyll samples by not inserting the 60 ml sample bottle inside the mason jar. Once the sample is obtained, the air-out tube can be used much like a straw to pour the sample from the mason jar into a nutrient bottle or other storage container. The sampler is best used for lakes under 45 feet deep, and should be checked periodically for leakage, since the metal jar lid can bend and its rubber seal may crack or degrade after several years of intensive sampling or neglect.

MAINTENANCE AND REPAIR OF THE WISCONSIN WATER SAMPLER

The sampler doesn't need a lot of maintenance. Rinse it with clear water and store where it will dry and won't get broken. It is best to store it away from direct sunlight, since sunlight speeds up the aging process for

polymers like those in the cords and sealants. High temperatures and solvents also can damage plastics, so avoid conditions that may result in degradation of materials.

To eliminate contamination by algae or other growth in the sampler, fill it with clear water to which a tablespoon of household bleach has been added. Let the bleach stand in the sampler for at least ten minutes, then rinse the sampler with several changes of clear water (until all trace of bleach smell has been removed).

TESTING AND RESTORING WATER TIGHTNESS

As with any piece of equipment used to gather scientific data, check the sampler occasionally to be sure that it works correctly. If the sampler is not completely sealed, water enters before it has reached the proper depth. This is more of a problem (and more likely to occur) if you are taking samples from deep water (over 30 feet). To test the seals, lower the sampler to the deepest level you sample, but don't pull the stoppers. After about 30 seconds, recover the sampler and see if there is any water inside. If there isn't, everything is fine. If there is water in the sampler, especially if it is filled to the bottom of the water-in tube or more, you will have to check all the seals. If the sampler leaks around the jar lid, the water will be mostly in the jar outside the sample bottle. If there is water in the sample bottle, the sampler probably leaks around the water-in and/or the air-out tube. Also, be sure the stoppers do not leak, either around the inside of the tubes or where the cords are attached.

If the leak(s) is around the wood block or the tubes, you may be able to reseal it with a waterproof adhesive. If the lid leaks where it makes a seal with the jar, even when the ring is tight, the seal area of the lid is probably damaged. You might be able to patch the seal area, but it is probably better to replace the lid. If the stoppers leak, you can try to reseal the hole where the cord enters or replace them with new ones from BIC™ pens. For more information contact the Wisconsin Self-Help Lake Monitoring Program, 608-266-8117.

CONSTRUCTING A SECCHI DISK

Secchi disks can be made out of many materials on hand. Generally they are constructed out of steel (1/8 inch thick), plexiglass (1/4 inch) or marine plywood (1/4 inch - 1/2 inch). The lighter materials must be weighted with washers or weights. Steel and wood disks must be painted on all sides. Plexiglass can be purchased in white opaque and the surface must be roughed with fine sandpaper and the disk warmed before painting. Flat enamel paint works best in most cases. The disks should be 20 cm (eight inches) in diameter and have a 3/8 inch hole in the center to accommodate an eyebolt.

Assemble disks with the eyebolt (5/16 inch diameter). Use flat washers between disk and nut, and between steel plate and locking washer. Use 5/16 inch nuts at top of eyebolt, and to bolt steel plate onto disk. For more information, contact Jeff Schloss.

MAKING A VIEWSCOPE

Using a viewscope may help increase the accuracy of Secchi disc readings by reducing interference from glare and wave action. For a viewscope, you will need:

- Four inch diameter PVC pipe, black inside
- One handle, three to four inches long
- Four screws and nuts (to attach handles)

Cut a two- to three-foot section of four-inch-diameter PVC pipe. If you can't find pipe with a black interior, paint the inside black. If the pipe is shiny black inside, use sandpaper to rough up the interior. Attach handle about six inches from one end.

Optional refinement: Programs that monitor in choppy waters may want to modify their viewscopes by adding a plexiglass window at one end. This prevents water from coming up inside the tube and interfering with visibility. Materials needed are:

- A four to five inch-diameter plexiglass disk
- PVC coupling
- Silicone rubber sealant

Glue the plexiglass disk to the bottom of the tube, using rubber sealant. Place a piece of PVC coupling over that end of the tube (like a collar) and seal with the silicone sealant. Drill two small (1/8 inch) holes in the side of the collar so that air won't be trapped in the open end of the coupling when you put the viewscope into the water. For more information, contact Jeff Schloss.

TALKING TRASH

Presenters: Lisa Younger, Center for Marine Conservation; Dave Redford, U.S. Environmental Protection Agency; and Philip Mummert, Tennessee Valley Authority.**

Lisa Younger

Center for Marine Conservation

THE INTERNATIONAL COASTAL CLEANUP

All of us at one time or another have visited the beach. Some are even fortunate enough to live within walking distance of the seashore. The complexion of our beaches may vary greatly from one area to another, but there is one constant: trash. No matter what beach we visit, no matter what time of year, the one thing we can be sure of finding on our coastlines is garbage.

We all know that garbage looks bad on our beaches and in our waterways, and it spoils the view we love to enjoy. But of even greater concern is the hazard this trash, particularly plastic trash, poses to wildlife. Thousands of marine mammals, sea turtles, seabirds and fish die every year from entanglement in debris such as rope, six-pack rings or monofilament fishing line, or from ingesting items like plastic bags and sheeting. Marine debris can also jeopardize vessel navigation by tangling propellers, causing damage and endangering human safety.

The sources of this trash are as varied as the trash itself, making it difficult to identify any specific group or individual. But the Center for Marine Conservation (CMC) has developed a program that not only gets this trash off the beach, but also identifies the sources responsible for putting it there.

The first CMC-coordinated beach cleanup was a statewide cleanup of Texas beaches in 1986. Organizers of this effort wisely realized that unless we find out exactly what types of debris were out there and begin to pinpoint sources of this debris, we will be doing beach cleanups for the rest of our lives, as well as our children's lives. Because of this foresight, when 2,800 volunteers turned out to participate in the cleanup, they not only collected trash, but also information on the types and amounts of trash they found. They used Beach Cleanup Data Cards designed by CMC that listed 41 different debris items and left space for volunteers to record other details, such as entangled wildlife they found or debris with identifying markings.

Volunteers at that first Texas cleanup recorded 171,496 individual debris items. This information was entered into the first Marine Debris Database, analyzed and compiled into the first beach cleanup report, giving us a profile of the debris littering Texas beaches. This report showed us that a significant portion of Texas beach debris was generated by shipping and cargo vessels, and provided the first of many directions for CMC to move to get to the sources of marine debris.

But the report did more than just inform us about Texas' marine debris problem; it gave a very sobering report of the extent of the marine debris problem throughout the United States. The report was used in Congressional testimony to support U.S. ratification of Annex V of the MARPOL Treaty, which put a halt to the dumping of plastic trash from ships at sea. The 1986 cleanup report was also used to support passage of the Marine Plastic Pollution Research and Control Act of 1987, which implemented Annex V in U.S. waters.

**Transcript Unavailable*

In 1988, CMC expanded beach cleanups to include all the coastal states in the nation. The resulting National Beach Cleanup was the largest, single-day cleanup ever, encompassing some 25 U.S. states and territories. Approximately 47,000 volunteers collected 1,953,800 pounds of trash from 3,518 miles of beach. Analysis of the data parallelled findings from the previous cleanups in Texas; About 65 percent of the trash collected was plastic, supporting earlier findings that plastics are the major component of our nation's marine debris.

Participation at beach cleanups has continued to grow at an amazing rate, from 65,000 volunteers in 1989 to 108,000 in 1990, to an estimated 130,000 in 1991. As it became more and more evident that the marine debris problem is global in scope, and that we alone could not solve it, the cleanup began to outgrow its U.S. borders. In 1989, Canada and Mexico joined the United States in the first North American coastal cleanup. The results of the Canada and Mexico cleanups again pointed to plastics as the number one problem in the marine environment.

Hopes were high as the 1990 cleanup date approached. With MARPOL's no dumping regulations in effect for one full year, cleanup organizers anticipated a decrease in the amount of debris collected. Unfortunately, the data told almost the identical story as in past cleanups. The percentage of plastics remained within two percent of the 1988 figures, with no significant decreases. This raises serious questions about the effectiveness of the MARPOL legislation, questions that are now being explored to find solutions to the marine debris problem.

What makes this event so attractive to so many people around the world? After all, picking up trash is not an activity that most of us would choose voluntarily. Comments from volunteers indicate that the most compelling reason for participating in the cleanup year after year is knowing that the information they collect is useful. The data collected by this army of volunteers has given us, for the first time, an accurate picture of the specifics of the marine debris problem. We now know that plastics make up the largest percentage of trash on our beaches. We also know that, while plastics are consistently high on all beaches worldwide, the sources of debris may vary greatly from one geographic area to another. For example, the Gulf of Mexico can attribute a significant portion of its beach debris to ocean-based sources, such as commercial fishing vessels and offshore activities, while Japan seems to have its biggest problem with land-based garbage carried to coastal areas through storm drains or left on the shore by beachgoers.

Because beach cleanup data points so clearly to the specific sources of trash, a variety of organizations are using the information to halt the flow of marine debris. For example, North Carolina State University uses the cleanup reports as baseline information to determine the economic impacts of marine debris. A steering committee in California used that state's cleanup data to develop the California Marine Debris Action, which has been accepted by the California legislature for implementation.

The detailed information supplied by cleanup volunteers often identifies actual organizations as the sources of marine debris. During the 1990 cleanup, volunteers identified 150 companies as sources of marine debris, by the labelling on trash they collected. CMC contacts each one of these companies individually, informing them of what debris was found, where and when. Response from these organizations has been positive and often has resulted in companies launching their own educational campaign about marine debris directed at their employees and/or patrons.

Detailed information on sources can also carry some sobering messages about the extent of the marine debris problem. For instance, plastic sheeting found by volunteers in Hawaii turned out to be from a passenger line that had not been in service for over 21 years! We are still collecting decades worth of trash and have a long way to go.

Another important aspect of the cleanup effort is information collected during these cleanups seems to indicate that legislation designed to solve the problem is having little or no effect. Are people ignoring the law? Do they even know about the law? Or do they realize that this may be an unen-

forceable regulation, given the manpower and resources available? Or is there just so much trash in our oceans that we are still collecting debris from years ago? These questions and many more are currently being explored by CMC and other organizations, including federal lawmakers, to determine what must still be done to solve this enormous problem.

Cleanups have helped increase public awareness of the need to recycle. Many cleanups recycle glass and aluminum beach debris, while several have begun to recycle plastics. For example, during Delaware's 1990 cleanup, plastic beach debris was collected, separated and taken to central locations in each county by the Delaware Automobile and Truck Dealers Association. The 5,000 pounds of plastic waste collected was then taken by DuPont for reprocessing by ARW Polywood. The plastics collected were returned to the state in the form of park benches to serve as a reminder of the importance of recycling. A similar cooperative effort between DuPont and Conoco was implemented in 10 coastal communities in Texas.

Keep in mind, however, that using volunteers in an effort the size of the International Coastal Cleanup does not readily lend itself to gathering scientifically specific information. But large-scale data collection efforts help give an overview of the specifics of a particular area, while instilling long-term thinking in the volunteer army. Cleanup volunteers greatly appreciate feedback regarding the accomplishments their efforts have made possible. In this bureaucratic time of forms for this and applications for that, it is easy for volunteers to view data collection as just another piece of useless paperwork. Indeed, CMC receives comments every year from first-time cleanup participants who are outraged when asked to spend their time filling out forms, when they feel it could be put to better use picking up more trash.

But once they receive the results of their data collection, volunteers realize the value of this added effort. In the case of the International Coastal Cleanup, a bi-annual newsletter, the *Coastal Connection*, is sent to all volunteers who completed the name and address portion of their data card.

And then there are the volunteers who want to do more. These are the groups and individuals willing to go out every day and do cleanups if needed. To utilize these people, who are often willing to put an enormous amount of effort into monitoring activities, CMC has taken the beach cleanup process one step further. In cooperation with the EPA, CMC is now testing a pilot statistical sampling project designed to scientifically monitor accumulation and movement of marine debris on a specific section of beach over an extended period of time. Once-a-month surveys are conducted by trained volunteer groups who record very specific information on the debris found in a specific section of beach area.

Workshop Session III: Implementing and Sustaining Projects

ENFORCEMENT AND COMPLIANCE MONITORING

Presenters: Michael Herz, San Francisco BayKeeper; Margaret Podlich, Center for Marine Conservation; and John Tiedemann, New Jersey Marine Sciences Consortium.

Michael Herz

San Francisco BayKeeper

The gigantic drydock containing the tanker loomed high above the small, white boat drifting slowly along its side. Clouds of sandblast dust swirled away from the ship's hull and settled gently onto the surface of San Francisco Bay next to the shipyard.

A crew member on the small boat dipped a five-gallon container over the side and skimmed a water sample from the gritty, grey surface layer of the bay. The skipper of the BayKeeper boat quickly shot several photos. He then noted the date, time, place and circumstances, completing the chain-of-custody form which would legally connect this sample to its origins as it travelled from the BayKeeper to the Regional Water Quality Control Board (RWQCB) and finally to the lab which would analyze it.

In this case, the analysis indicated that the sample contained 65,000 ppb of copper, more than 20,000 times higher than permitted in San Francisco Bay water — hundreds of thousands times above levels demonstrated to be toxic to fish and shellfish. This sample was also found to contain illegally high levels of chromium, lead and nickel, all of which have been demonstrated to be carcinogens.

Based on this information, the enforcement agency ultimately required the shipyard to install protective curtains to reduce airborne sandblast dust and paint, and physical barriers to prevent toxic sandblast waste from running into the bay. The cost of these modifications, several hundred thousand dollars, may be high, but the protection of San Francisco Bay and its resources seems well worth it to those of us committed to enforcement monitoring.

However, this is not typical of what is happening to polluters around the country. In most areas, no one is minding our bays, rivers, harbors and coastlines. The Clean Water Act (CWA) requires dischargers to have National Pollution Discharge Elimination System (NPDES) permits that limit the concentration of specific substances they can discharge into the nation's waters. The CWA also says that enforcement will be carried out by the Environmental Protection Agency or by state agencies to which regulatory authority has been delegated.

But in most areas of the country, budget and personnel constraints mean that agencies have no on-the-water enforcement presence and are unable to conduct regular water sampling. Instead, compliance with NPDES permit conditions is sought through self-monitoring programs. (When was the last time you wrote yourself a speeding ticket?)

A decade ago, the San Francisco Bay RWQCB had a water monitoring vessel working full time, regularly sampling bay water quality at the outfalls of the nearly 200 municipal and industrial dischargers. Today, this agency has no program for monitoring receiving water, not even spot checks, and sometimes it is forced to request the BayKeeper boat as a platform for sampling. Similarly, the U.S. Coast Guard used to conduct primary mission pollution patrols twice daily around the bay. Today there are none.

Enter the "keeper" programs. (In addition to the San Francisco BayKeeper, there are Hudson and Delaware River Keepers, Long Island and Puget Sound Keepers, and the New York- New Jersey Harbor and Casco Bay Keepers.) This is the grassroots response to an obvious enforcement vacuum. All are

dedicated to protecting their local water bodies — to finding and stopping sources of pollution. But each is organized somewhat differently, reflecting the uniqueness of the individuals and organizations involved, the variety and severity of local environmental problems, the degree of agency cooperation, the availability of funding and other factors.

All of the keeper programs conduct some type of environmental monitoring. These range from systematic sampling to determine long-term trends in entire water bodies (temperature, turbidity, pH, salinity, dissolved oxygen) to stake-outs designed to collect samples from known or suspected sources of pollution and to analyze them for heavy metals, coliform bacteria, pesticides and/or petroleum products — data designed to be used to get convictions under the CWA or other regulations.

In different programs, samples are analyzed in keepers' own labs or farmed out to commercial, regulatory agency, academic or nonprofit organization labs, such as the Citizens' Environmental Laboratory operated by the National Toxic Fund in Boston. The data from such monitoring efforts have been used as key evidence in successful CWA citizen suits against industries and municipalities. They have produced significant fines and settlements, which have been used to acquire threatened habitats or to create mitigation for damaged environments (Hudson River and Long Island Sound). In other cases, data collected by BayKeeper volunteers have led agencies to implement new regulatory programs against previously unregulated polluters or to begin to reform their penalty-setting procedures (San Francisco Bay).

You don't have to be a water quality chemist to catch and stop polluters. Some of the data that have led agencies to initiate enforcement have been still or video pictures. Commercial fisherman hamming it up in front of our video camera (which they thought was being operated by a tourist from Kansas) while they pumped their oily bilges at Fisherman's Wharf are currently facing Coast Guard fines. Photos and a declaration from a BayKeeper kayaker have led to an EPA criminal investigation which already has resulted in a $210,000 fine being levied against another San Francisco Bay area shipyard for improper storage and handling of hazardous materials.

While we recognize the importance of routine monitoring as a basis for describing trends in water quality, one of the principal objectives of the keeper programs is enforcement. It simply is not being done adequately by the agencies that have the mandate. Budget and personnel cuts have made their job nearly impossible. For example, the current field staff of the San Francisco Bay Regional Water Quality Control Board, the agency delegated CWA enforcement authority by EPA for the 400-square-mile bay (with 700-plus miles of shoreline), is two people, double the size of two years ago!

The agencies are cautiously supportive of our work. They view us as an asset; we can collect samples and detect violations for them. But we are a threat as well; we can and do publicize the problems they are unable or unwilling to tackle. We have a large volunteer base — boats, planes, a helicopter and hundreds of volunteers dedicated to protecting the bay by stopping pollution. And we can set our priorities independent of political pressures or industries happy to pay even large fines if they can continue to pollute.

From the perspective of the seven existing keeper programs, we are part of a movement. We believe citizens want our waters to be swimmable and fishable as required under the Clean Water Act, and that they are angry both at polluters' selfish behavior and at regulators' failures. We get inquiries about how to start keeper programs from around the country (and the world) that indicate a sense of commitment to hands-on solutions to our critical problems of polluted rivers, bays and coastal areas.

All of us have a vested interest in the quality of our bays, rivers and coastal areas. The important resources contained in these waters are our heritage, and we should be clear that we are only borrowing their use from our children and their future. The abusers who we seek to stop need to know that all of our citizens care, that we will document their pollution and sue them when they won't stop — that we're mad as hell and we're not going to stand it anymore!

Margaret Podlich

Center for Marine Conservation

John Tiedemann

New Jersey Marine Sciences Consortium

DEVELOPING THE CITIZEN POLLUTION PATROL PROJECT

In 1987, the Marine Plastic Pollution Research and Control Act (MPPRCA) provided for United States ratification of MARPOL Annex V, the International Regulations for the Prevention of Pollution by Garbage from Ships. These regulations apply to all U.S. ships, except certain government-owned or operated ships, including commercial fishing vessels and privately owned recreational boats, wherever they operate. In addition, all foreign vessels operating in U.S. waters out to and including the Exclusive Economic Zone (200 miles) must comply with these regulations.

Under the regulations, it is illegal for any vessel to dump plastic trash anywhere in the ocean or navigable waters of the United States. In addition to prohibiting the discharge of plastics in coastal and ocean waters, MARPOL makes it illegal to dump all other types of trash in inland waters and ocean waters out to three miles from shore. Further offshore, various other disposal restrictions apply.

The MPPRCA requires vessels that are 26 feet or more in length to display placards that notify passengers and crew of marine debris discharge regulations and penalties for violations. The regulations require oceangoing vessels of 40 feet or more to have written waste management plans on-board.

The U.S. Coast Guard is responsible for enforcing MARPOL Annex V and the MPPRCA regulations. To help reduce the marine debris problem, Section 2204 of the MPPRCA requires the U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA) and the Coast Guard to encourage the formation of volunteer groups, designated as Citizen Pollution Patrols, to assist in the monitoring, reporting, cleanup and prevention of ocean and shoreline pollution.

In 1991, the Center for Marine Conservation (CMC) received a grant from EPA to design and test a Citizen Pollution Patrol project. Working in conjunction with the New Jersey Sea Grant Marine Advisory Service and Coastal Environmental Services, two projects were conducted, one in the Port of Annapolis region of Maryland and one in the Port of Manasquan, Greater Barnegat Bay area of New Jersey. The projects were designed to:

- Increase awareness of the marine debris problem in the maritime community;
- Educate the boating population in the project areas about MARPOL Annex V;
- Bring members of key marine user groups into compliance with MARPOL Annex V;
- Test a pilot program where citizens report violations.

OVERVIEW OF MARINE DEBRIS LAWS

Since the Coast Guard has issued the final interim rules for implementation of MARPOL Annex V and the MPPRCA, guidance concerning vessel enforcement policy, vessel discharge violation investigation and reporting requirements for the discharge provisions of Annex V has been developed by Coast Guard Headquarters in Washington, D.C. In the field, each regional Coast Guard Captain of the Port or Marine Safety Office determines the optimum approach to encourage compliance.

The Coast Guard began enforcing regulations on garbage disposal at sea in May 1989. At present, the Coast Guard is not doing any at-sea boardings exclusively for the enforcement of Annex V. Search and rescue operations remain their highest priority. Compliance with the regulations is mainly being ascertained during other operations, including boardings and safety inspections. Violations by ships at sea are being identified during Coast Guard boardings unrelated to MARPOL, or through interviews of ship personnel or investigation of passenger reports. While ships are in U.S. navigable waters, they may be inspected by the Coast Guard.

On routine inspection, patrols check to see that ships have not discharged plastics or other garbage in violation of the MPPRCA or Annex V.

A variety of other legislation and regulatory agency initiatives address debris in the marine environment. For example, in Maryland part of the state litter law applies to state waterways, and in New Jersey provisions of the state fish and game statutes prohibit the introduction of any material, including debris of any kind, into fresh or tidal waters of the state.

In addition, many municipalities have also adopted ordinances and regulations in an attempt to control littering within their communities. While approaches vary, they all prohibit the disposal of waste materials defined as litter within the boundaries of that municipality, including marinas and dockage facilities, the waterfront or water bodies within the community. Many municipalities have also adopted recycling ordinances as elements of their solid waste management plans. However, at present these programs are not in existence in all coastal communities.

THE CITIZEN POLLUTION PATROL

In order to enable citizens to document and report suspected violations of marine debris laws, a mechanism to facilitate an effective response to citizen reports had to be developed. Meetings with interested local, state and federal regulatory and enforcement agencies were held to enlist their participation in the Citizen Pollution Patrol Program. The possibility of establishing a procedural protocol for reporting violations of MARPOL Annex V and the MPPRCA regulations to local and state agencies was discussed.

All of the local and county agencies contacted indicated that local jurisdiction along the waterfront generally is considered to end at the shoreline, and that marine debris-related incidents would likely be referred to the marine law enforcement unit of the state and the Coast Guard, if appropriate. In addition, although the project interested many of the agencies, most were unwilling to commit to active participation in the Citizen Pollution Patrol Program because of questions related to jurisdiction, staffing and budgetary constraints.

During the discussions with the Coast Guard it was noted that a number of factors make enforcement of Annex V difficult, including the great number of ships affected by the regulations, a huge enforcement area, the difficulty in determining the source of plastic and other debris once it is dumped overboard, and concern over how high of a priority plastic and garbage control should be, when compared to search-and-rescue missions and control of illegal drug traffic by Coast Guard personnel. One measure that would help overcome these difficulties would be to dedicate more resources to effectively enforce MARPOL; however, this has not occurred.

In both New Jersey and Maryland the local Coast Guard stations indicated that they could not take on enforcement activities related to reports of marine debris, especially reports received from citizens, due to their other responsibilities. In Maryland, the Coast Guard requested that the smaller violations be reported to another enforcement agency like the Maryland Natural Resources Police. In contrast, the New Jersey Marine Police suggested that violations should be reported to the Coast Guard. Thus, the development of similar projects in different coastal regions reflects quite a dichotomy.

As a result of these efforts, the Coast Guard Marine Safety Office in Philadelphia and the Maryland Natural Resources Police did agree to participate in the project and a final strategy to facilitate citizen reports of violations of MARPOL Annex V and the MPPRCA was developed. Citizen Pollution Patrol Report Forms were distributed to interested boaters and anglers. These forms were designed to provide information needed by the cooperating enforcement agencies. Arrangements were made to forward Citizen Pollution Patrol reports to the Coast Guard MSO Philadelphia Office (New Jersey project) or the Maryland Natural Resources Police (Annapolis project). These agencies would then track the owner of the reported vessel via the vessel registration number and forward a packet of educational materials to the vessel owner or determine if enforcement action would be taken.

RESULTS OF THE CITIZEN POLLUTION PATROL

Few citizen reports of MARPOL violations were received as a result of the Citizen Pollution Patrol. However, it should be noted that the project resulted in thousands of boaters learning about the opportunity for citizen reports of MARPOL Annex V violations. In addition, the Coast Guard MSO Philadelphia, Coast Guard Group Sandy Hook, and Maryland Natural Resources Police have indicated that they would consider participating with the Citizen Pollution Patrol in the future.

Although enforcement of Annex V may be difficult, educating the public about the problems of marine debris and the requirements of Annex V offers an effective means to combat the problem at the source by influencing compliance decisions. Voluntary compliance through education has been shown to be an effective means of achieving the policy objectives of MARPOL during the Citizen Pollution Patrol Program.

Through the Maryland and New Jersey Citizen Pollution Patrol projects, tens of thousands of boaters and marina operators were exposed to information about the problems and solutions to marine debris. MARPOL Annex V and the MPPRCA regulations were explained to environmental, fishing and boating organizations through seminars, workshops, media presentation, attendance at trade shows and local forums in the project areas. Boaters and fishermen were also assisted in complying with the placarding and waste management plan requirements of MARPOL Annex V.

IMPLEMENTING A VOLUNTEER-BASED COMPLIANCE MONITORING PROGRAM

To design an effective program in which citizens can document specific violations of an environmental law or regulatory program, regardless of the particular environmental issue, it is essential that project personnel become completely knowledgeable about the provisions of the applicable laws and regulations. This is a time-consuming process, but well worth the effort. Once versed in the law and regulations of concern, it is vital to meet with the agencies responsible for implementing them in order to obtain a working knowledge of how permits are granted and enforcement cases built. Pay particular attention to what pieces of data are essential for enforcement cases.

Next, determine the ability of volunteers to provide useful information that fosters enforcement or enhances existing monitoring efforts. Know your limitations as well as assets. Have a clear objective for collecting data and a well-planned procedure for initiating action once that information is at hand.

If volunteers are going to record observational data or sample and test results, it is essential to create standardized procedures for data collection. This includes development of standardized reporting forms and formats. As in the case of the Citizen Pollution Patrol project, seek agency participation in developing reporting procedures and promote a commitment from the enforcement agencies to use citizen input provided through the project.

COMPUTER DATA MANAGEMENT

*Presenters: Ray Norris, Tennessee Save Our Streams, Izaak Walton League of America; Marcy Judd, Alliance for the Chesapeake Bay; and Chetan Desai, Virginia Polytechnic Institute and State University.**

Ray Norris

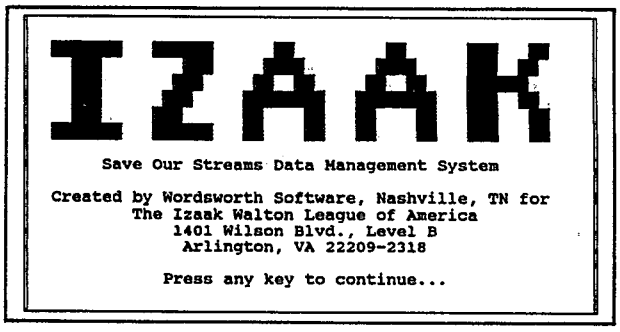
Tennessee Save Our Streams

WELCOME TO IZAAK

IZAAK is a comprehensive software program for recording, storing, analyzing and reporting data stemming from the Izaak Walton League's Save Our Streams survey procedures. IZAAK was created in 1992 by Henry Parmer, a Tennessee SOS volunteer stream monitor, for use with volunteer monitoring survey procedures and forms. Written in Clipper language, it can be installed and run on any IBM/AT compatible PC with two megabytes of hard disk space available and MS-DOS Version 3.3 or higher installed. Data entered into IZAAK is stored in dBase files which can be imported into other dBase systems with compatible file structures and character fields.

There are no templates of complex key stroke combinations required and no detailed procedures to be remembered to use IZAAK. Conventional commands are used, where possible, and allowable operations and procedures for executing them are generally displayed on each screen, practically eliminating any need for special help routines.

IZAAK is a fully operational data entry and information retrieval system. There remain a few places, however, where minor cosmetic adjustments are needed to improve the appearance of some screens and the format of some reports. New users may detect some bugs. With that disclaimer of perfection, let me turn the computer on and walk you through IZAAK.



IZAAK's main menu appears automatically after a 20-second display of the title screen or if you hit any key. You may choose to work on People, Groups, Locations or Samples files by using the arrow keys to highlight your choice or by typing in the initial letter of the file you wish to activate. **ENTER** will select the highlighted file.

Since there are look-up routines which can be used in both data entry and data viewing, it is a good idea to enter People information first so that you can look up group leaders from the People file in creating the Groups file. Creating the Location files next makes it possible for you to use automatic look-up procedures for both locations and groups when creating or viewing Samples data. This sequence eliminates the need for separate lists of member, group and location identification numbers. So, typing **P** and **ENTER** on the main menu below will bring up data on the first member in an alphabetic listing.

**Transcript Unavailable*

```
Samples   Locations   Groups   People   Reports   Utilities   Quit

                    Add/inspect water quality samples
```

```
REVIEW MEMBERSHIP INFORMATION

  ID #1010052  Last name: ARMETTA                 First name: NANCY
  M or F: F  Title: PHYSICIAN
  Organization: WAYNESBORO BAPTIST HOSPITAL
  Address: RT. 3, BOX 448

  City: WAYNESBORO                 State: TN  Zip: 38485
  Home: (615) 722-9142   Work: (615) 356-0770
  Izaak Walton League member: N   Tvanet: N
 Comments
Dunmire Hollow Community.  Husband Steve Qubeck. Children Theron & Adanta.
Active in home schooling movement.

  Use ↑ ↓ - <HOME> <END> keys to move through file, OR <F2> = ADD, <F3> =
  CHANGE, <F4> = DELETE, <F5> = SEARCH, <F8> = EDIT comments or <ESC> = EXIT
```

Use arrows to move through the People file to locate data on other members, or, to reduce the amount of scrolling required, strike **<F5>** and the initial letter of the surname of the person you are seeking. You will note that you are also given the option of searching by identification number. The arrow on the line below the column headings on the search screen indicates that more information can be obtained on each member by using the right arrow. Once the name of the proper person has been highlighted, pressing **ENTER** will select that file. If there are no data entered for the person being sought, you can press **<ESC>** and **<F2>** to activate the membership data-entry screen.

```
REVIEW MEMBERSHIP INFORMATION

  ID #1010052  Last name: ARMETTA                 First name: NANCY
  M or F: F  Title: PHYSICIAN
  Organization: WAYNESBORO BAPTIST HOSPITAL
  Address: RT. 3, BOX 448
                          Search by:
  City: WAYNESBORO                  : 38485
                          Name   Id Number
  Home: (615) 722-9142
  Izaak Walton League member: N   Tvanet: N
 Comments
Dunmire Hollow Community.  Husband Steve Qubeck. Children Theron & Adanta.
Active in home schooling movement.

  Use ↑ ↓ - <HOME> <END> keys to move through file, OR <F2> = ADD, <F3> =
  CHANGE, <F4> = DELETE, <F5> = SEARCH, <F8> = EDIT comments or <ESC> = EXIT
```

```
REVIEW MEMBERSHIP INFORMATION

  ID
  M o
  Org
  Add
  Cit
  Hom
  Iza
  Co
Dunmire
Active
```

LASTNAME	FIRSTNAME	ID
ARMETTA	NANCY	1010052
BALL	MARY	1010018
BARRIGAR	GARY	1010015
BLANKENSHIP	BOB	1010043
BOONE	DANIEL	1010012
BROWN	BOB	1010005
CLEMMER	JENNY	1010040
COUCH	JOHN	1010013
COUCH	TERESA	1010025
DALTON	MIKE	1010016
DARNELL	LARRY	1010008

```
 Memo field: COMMENTS
Dunmire Hollow Community.  Husband Steve Qubeck. Children
Theron & Adanta. Active in home schooling movement.
                                                        nta.
 Database Lookup:
  Use ↑ ↓ - <PAGE UP> <PAGE DOWN> to move through file OR <ENTER> to select
  <ESC> to exit with no selection OR enter letters/numbers to FIND MATCH
```

Similar procedures are followed to identify the leader when setting up a Groups record. If you do not enter the identification number of the group leader, you will be asked if you wish to skip leader designation. If you answer **NO**, you will be put into a search routine among members. You will note in completing the Groups data form that **<CTRL-W>** will save any entry you make in the memo field. This is the standard instruction for saving all memo fields in IZAAK.

```
ADD RECORDS TO GROUP INFO FILE

  Group #1010045   Group Name: DUNMIRE HOLLOW COMMUNITY
  Group Leader ID #1010052   Name: NANCY ARMETTA
 Group Notes
Monitor 48Creek, Hurricane Creek, and other streams in Waynesboro area.

  You may now enter Group Notes. When finished, press <CTRL-W> to save entry,
  or <ESC> to exit without saving entry.
```

Locating a sample monitoring site already in the files follows the same procedures used in locating People and Groups, including automatic search for the stream on which the site is located. Before entering a new location, however, you will need to determine from a topographic map the latitude and longitude of the site in degrees, minutes and seconds. You will need also to obtain the catalog unit number for that watershed from a Waterbody System Hydrologic Unit Map. River segments and mile information for major tributaries can be obtained from WBS Reach Files, but it is unavailable for many branches monitored by SOS volunteers. Segments can be designated in IZAAK by three numerals or up to two letters and a third-place

numeral. Very specific location information in the memo field is helpful.

```
REVIEW LOCATION INFORMATION        Last Counted on:   /  /

                    CAT UNIT-SEG-MI
Location #:1010099  06040004-481-   0.0   Location: BELOW US RT. 64 BRID

Stream: 48 CREEK                    County: WAYNE

Latitude:  35° 20m 40s -N-    Longitude:  087° 39m 45s -W-

Location Description
Below US Rt. 64 Bridge, 50 yards upstream from Geisler's Branch.

Use ↑ ↓ - <HOME> <END> keys to move through file,  OR <F2> = ADD, <F3> =
CHANGE, <F4> = STATUS, <F5> = SEARCH, <F6> = CHANGE ORDER or <ESC> = EXIT
```

To add sample data for a given location, you highlight Samples and press **ENTER**. When Add is highlighted, press **ENTER** again.

```
Samples   Locations   Groups   People   Reports   Utilities   Quit
 Add
 View

        One moment please: Setting up Data Entry Screens

                    Add samples to file
```

Following instructions at the bottom of screen one, use the **<F5>** search procedure for location and for group if that information exists in Locations and Groups files. Enter information about other stream conditions, noticing that the cursor will advance automatically if all spaces for an item are filled or if ENTER is pressed. The exception is for flow rate where **ENTER** selects the highlighted rate and **<ESC>** is used to advance the cursor.

You will note that IZAAK permits the entry of three possible types of test data: "mci" will set up a six-screen data entry routine for benthic macroinvertebrate data; "chemical test" will set up one data entry screen for the Hach Fish Farmer Test Kit parameters used in Tennessee; "other" will open a memo field for recording miscellaneous data such as fecal coliform and fecal strep, stream environment evaluations and sniff tests for petroleum pollution. If more than one type of test is to be reported for a given date and location, screen one stream condition data will have to be entered for each test. If you have made any error in entering data on screen one (or subsequent screens), indicate **N** when asked "Are you finished with this screen? You will then be given an opportunity to change your data entries.

```
-> SCREEN #1: STREAM CONDITIONS <-

LOCATION:

COUNTY:                          STREAM:

GROUP:                                          PARTICIPANTS:

WEATHER CONDITIONS:

STREAM WIDTH (MAX):        Ft.  STREAM DEPTH (MAX):       Ft.

FLOW RATE:   high   low   medium

WATER DEPTH:       Inches    WATER TEMPERATURE:      °F

SAMPLE NUMBER:     DATE:              TIME:

TYPE OF TEST:   mci count   chemical test   other

Enter a LOCATION NUMBER or press <F5> for LOOKUP, <F2> to ADD LOCATION or
<ESC> to exit samples entry
```

Screen two has different screens for the different types of tests. The chemical test screen follows.

```
-> SCREEN #2: CHEMICAL TEST <-

TEST                          RESULT          BACKUP

Dissolved Oxygen: mg/l         9.0             9.0

Water Temperature:  C         18.33    C      18.33    C

pH: Standard Units             7.5             7.5

Total Hardness: mg/l           0.0             0.0

Alkalinity: gr/gl              0.00            0.00

Chlorides: mg/l                0               0

Carbon Dioxide: mg/l           0               0

Ammonium-Nitrogen              0.0             0.0

Nitrite-Nitrogen: mg/l         0.00            0.00

Total Phosphates: mg/l         0               0
```

The mci screen two provides an opportunity to enter A, B or C (or no entry) for each type of benthic macroinvertebrate obtained in the sample collected. When all specimens have been recorded, **<ESC>** will cause the program to calculate the Water Quality Index. Note carefully the default values for each survey item on screens three, four and five. **ENTER** will select highlighted responses and **<ESC>** will step the cursor from one item to another.

```
-> SCREEN #2: MACROINVERTEBRATE COUNT <-

SENSITIVE                  SOMEWHAT-SENSITIVE          TOLERANT

A caddisfly larvae         beetle larvae               aquatic worms
A hellgrammite             clams                       blackfly larvae
B mayfly nymphs            crane fly larvae            A leeches
C gilled snails            A crayfish                  midge larvae
  riffle beetle adult      A damselfly nymphs          pouch (and other snails
B stonefly nymphs          dragonfly nymphs
C water penny larvae       scuds
                           sowbugs
                           A fishfly larvae
                             alderfly larvae
                             atherix

6 letters                  3 letters                   1 letters
  times 3 =                  times 2 =                   times 1 =
18 index value             6 index value               1 index value

Total Index Value = 25 = EXCELLENT

Finished with the Macroinvertebrate count? Y/n Y
```

```
-> SCREEN #3: WATER QUALITY AND STREAM DESCRIPTION <-
FISH WATER QUALITY INDICATORS:      BARRIERS TO FISH MOVEMENT:
 *scattered individuals              beaver dams
 *scattered schools                  dams
  trout                              waterfalls
  bass                               other
  catfish                           *none
  carp
  none observed                     ODOR:
                                     rotten egg
SURFACE WATER APPEARANCE:            musky                 STREAM BED STABILITY:
 brownish                            oil                   *no spots
 *clear                                                    spots
  colored sheen (oi  Are you finished with this screen? Y/n Y  pots
  foamy
  milky                             STREAM BED DEPOSIT:
  muddy                              grey
  brown                              orange/red
  black                              yellow
  grey                               black
  other                             *brown
                                     other

Use arrow keys to position highlight, then press <ENTER> to make up to 1
selections, or press <ESC> to leave the list. Default NO SPOTS.
```

Screens four and five permit the entry of textual information in response to some survey items. By choosing "percent bed cover" in describing where algae is located, you are given an opportunity to indicate what that percent is estimated to be. Indicating that there is a high, moderate or slight likelihood of "other" threats to the watershed opens a memo field on which that other threat can be described. Similarly, indicating a threat to the watershed from croplands calls for an indication of what those crops are.

```
-> SCREEN #4: FURTHER STREAM DESCRIPTION <-

% BANK COVERED BY PLANTS, ROCKS
AND LOGS (NO EXPOSED SOIL) IS:          Good        Fair        Poor
Stream bank (sides)                  * > 70%      30% - 70%    < 30%
Top of bank (slope & floodplain)     * > 70%      30% - 70%    < 30%

STREAM BANK VEGETATION COMPOSITION:   20% shrubs  10% grass  70% trees

STREAM BANK EROSION:                   > 80% severe          50% - 80% high
                                       20% - 49% moderate  * < 20% slight

BED COMPOSITION OF RI                                        ALGAE LOCATED:
  0% silt (mud)   Enter percentage of bed cover: :15:        everywhere
  5% sand (1/16" - 1/                                        in spots
 15% gravel (1/4" - 2" stones)      brown coated                % bed cover
 80% cobbles (2" - 10" stones)      matted on stream bed
  0% boulders (> 10" stones)        hairy

Use arrow keys to position highlight, then press <ENTER> to select up tl
items, or press <ESC> to leave the list. Default is   no entry.
```

Entries can be made in the screen six memo fields by highlighting the appropriate field and pressing the **ENTER** key. IZAAK will save the contents of each memo when **<CTRL-W>** is pressed. Before exiting from the data-entry routine for a given site on a given date, IZAAK will ask if you are finished with that sample. If you indicate that you are not, you will be cycled back through all screens to make any changes you wish.

```
-> SCREEN #5: LAND USE AND DISCHARGE PIPES <-

Land uses in watershed: high (H), medium (M) or slight (S) impact?

  Housing Developments          Forest                  Oil & Gas Drilling
  Urban Uses (Parking lots)   S Logging                 Sanitary Landfill
  Other                         Cropland                Construction
                                Fields                  Mining
                              S Livestock Pasture       Refuse Dump

Are there any discharging pipes? Y/N  N      How many? 0

What types of pipes are there?        Runoff
     Sewage Treatment             Industrial

                  Are you finished with this screen? Y/n Y
```

```
-> SCREEN #6: LITTER AND THREATS TO WATER QUALITY <-
-> Percent and type of litter around stream
5% cans & bottles

-> Comments
Individual family dumps. Hazardous waste disposal site proposed by regional
corporation.
                  Are you finished with this sample? Y/n Y

Select a category to EDIT or press <ESC> to exit
```

After leaving the sample entry routine, you may choose to "view" sample entries already made. To do so, highlight "view" and press **ENTER**. IZAAK will bring call up the entry for the first stream in a numerical, then alphabetic listing.

```
VIEW SAMPLES
   Location #1010099 BELOW US 64 BRIDGE 4S CREEK WAYNE
   Group: 1010045 DUNMIRE HOLLOW COMMUNITY
   Date: 10/17/91  Time: 11:00  Sample #1 Participants:  7 Water Temp: 62.0°F
   Depth: 18.0"  Weather Cnd: 0 DEGREES
   Sample Type: MACROINVERTEBRATE COUNT  Result: EXCELLENT! = 25

MAX Stream Width: 25.0ft.  Depth:3.0ft.  Flow rate: LOW
% bank covered by plants, rocks and logs (no exposed soil) is
Stream bank (sides): > 70% (GOOD) Top of bank (slope & floodpl): > 70% (GOOD)
Stream bank vegetation: 20% shrubs  10% grasses  70% trees
Stream bank erosion: < 20% - 0% (SLIGHT)

Use ↑ ↓ -  <HOME> <END> to move through file, OR <F3> = CHANGE <F4> = DELETE
<F5> = SEARCH <F6> = change VIEW <F8> = view MEMO fields <ESC> = EXIT
```

Once again, IZAAK will speed your search if you strike **<F5>** and the initial letter of the stream on which you want information. Using the arrow keys, you can look through all the sample results entered for that particular site, beginning from the earliest through the most recent. If you detect an error while viewing sample information, you can call up an individual data entry screen by highlighting it and pressing **ENTER**. The **<F3>** command will open that screen so that changes can be made.

```
VIEW SAMPLES
   Location #1010001 RM 27.6 BLUE WATER CREEK LAWRENCE
   Gro
   Dat  STREAM                          LOCNAME                          : 59.0°F
   Dep
   Sam  48 CREEK                        BELOW US 64 BRIDGE
        BACK CREEK                      BELOW CARDON HOLLOW BRIDGE
 MAX St BEAVER CREEK                    BEAVER CREEK AT PHILLIPSWOOD
 % bank BEAVER CREEK                    BEAVER CREEK AT RT 37
 Stream BIG SWAN CREEK                  FAR UPSTREAM                     % (GOOD)
 Stream BIG SWAN CREEK                  FARTHEST DOWNSTREAM
 Stream BIG SWAN CREEK                  JUST UPSTREAM OF DUMP RAVINE
        BLUE WATER CREEK                RM 27.6
        BRIAR FORK                      BEAN STATION 4-H
        BRUSH CREEK                     BRUSH CREEK (CHEATHAM CO.) #
        BRUSH CREEK                     LOWER: NEAR SEWAGE TREATMENT
        Memo field: LOCDESCR
        Below US 64 bridge, 50 yards upstream from Geisler's Branch.

   Database Lookup:
   Use ↑ ↓ → <PAGE UP> <PAGE DOWN> to move through file OR <ENTER> to select
   <ESC> to exit with no selection OR enter letters/numbers to FIND MATCH
```

Keeping IZAAK's files in order, saving them to backup disks, or preparing them for export is the task of the utilities programs. All these operations are accessed by highlighting the utilities files and pressing **ENTER**. Highlighting the desired operation and pressing **ENTER** again will initiate the desired activity.

```
Samples   Locations   Groups   People   Reports   Utilities   Quit
                                                  Pack and re-index files
                                                  Back up data files
                                                  Restore files from disk
                                                  Change system defaults
                                                  Add Catalog Units/Segments

                    Useful stuff like file purge/backup, etc.
```

As indicated earlier, IZAAK's files are Dbase files, and the data contained in them can be processed through dBase. There are certain reports that are needed so often that IZAAK will generate them for you. Monitors and decision-makers often want to know if water quality is being degraded or enhanced at a given location over time. Report one will provide the history of that site. Agency officials often wish to obtain an overall picture of a given stream. Report two will give it to them. To identify possible pollution sites and/or detect recovery zones, citizen activists and agency officials may wish to look at macroinvertebrate test results down through an entire stream segment. Report three will provide the necessary data, and report four will identify sections where there is a "detectable" difference in water quality indices based on the invertebrate counts.

```
Samples   Locations   Groups   People   Reports   Utilities   Quit
                                          Sample Reports
                                          Members List
                                          Group List
                                          Location List
                                          Catalog Units

Report 1  History of MI counts at a single site
Report 2  Water quality ratings for given stream
Report 3  MI counts for given stream, from headwaters to mouth
Report 4  MI count variation greater than 2 index points between sites
Report 5  Comparison of two different locations by date
Report 6  History of dates samples taken, by site or team leader
Quit

                    Share the information
```

To facilitate either "repeated measures" or "matched watershed" research design comparisons, report five will provide comparative data on (a) the same site on different occasions, (b) different sites on the same occasion, or (c) different sites on different occasions.

Finally, the coordinator of stream monitoring activities often needs a way to check quickly on whether or not his monitoring teams are active and how regularly given sites are being monitored. Report six will keep track of this information.

As you can see, IZAAK is not a generic program adaptable to all water-quality monitoring activities. It is tailored specifically to the stream-quality assessment protocol and forms employed in the Save Our Streams program of the Izaak Walton League. For those organizations who have adopted the SOS procedures, however, IZAAK will provide an inexpensive and efficient system for storing, manipulating and reporting stream survey information. For more information about IZAAK, contact Ray Norris, Tennessee SOS Coordinator, Izaak Walton League of America, 4021 Sunnybrook Drive, Nashville, Tenn. 37205-3834; 615-665-2324.

Marcy Judd

Alliance for the Chesapeake Bay

MANAGING CITIZEN DATA

I am the coordinator for the Virginia Citizen Monitoring Program. Today, I will focus on the expanded Virginia program and some management

tools we use: the watershed coordinator system and the data management software we call "CitMonMAN" for Citizen Monitoring Data Management.

Since 1985 the Virginia program has expanded from 16 sites on the James River to 75 sites on the Elizabeth, James, York, Piankatank, Rappahannock and Shenandoah Rivers, Nomini Creek off the Potomac, as well as the Bayside and seaside creeks of the Eastern Shore and six riparian state parks around the state. Scheduled expansion for 1992 includes 10 new sites on the Eastern Shore, 10 sites on the Mattaponi and Pamunkey Rivers, and 10 nutrient sampling sites near the main stem.

Currently, funding for the Virginia program is provided by the Virginia State Water Control Board and the Coastal Zone Management Program of the National Oceanic and Atmospheric Administration, administered by the Virginia Council on the Environment.

All monitors record information on data sheets, which include monitor number, site number and name, air and water temperature, secchi depth and water depth, hydrometer reading and temperature in the hydrometer jar to calculate salinity, pH, and the average of two dissolved oxygen tests. The form also covers more subjective data about water surface, weather, water color and relevant comments. Some monitors also test for ammonia and nutrients; there is also room on the form to record wildlife observations.

With 75 monitors sending in 52 data sheets a year, we collect 3,900 records that need to be separated by river, collated by date and checked for accuracy before they are ready for data entry.

To decentralize management of volunteers and better handle data, we developed the watershed coordinator system and data management software.

We divided the group into 10 smaller groups of about 10 monitors each headed by a watershed coordinator. Each watershed coordinator acts as a trouble shooter and relays messages to the coordinator. We gave each watershed coordinator a copy of CitMonMAN. They collect data sheets from monitors and enter them into their own computers, which are copied on disk and mailed to the Richmond office where we can easily import them every month. With CitMonMAN, we can store the data in a standardized format. We anticipate that state managers will use this citizen-generated data in assessing the status of surface waters because we generate data reports in a format suitable for inclusion into the State Water Control Board's 305(b) reports to Congress. As far as our monitors are concerned, we have the ability to give them timely feedback in the form of tabular reports and graphs.

Specifically, CitMonMAN has three databases: site information, monitor information and monitoring data. Site information must be entered first, then monitor information and last, monitoring data.

From the main menu of CitMonMAN, use the arrow keys to move across the menu and highlight different functions. The descriptive line underneath tells you what each function does. First enter information about a new site. Choose Entry, Site(s) and the site information form appears.

SITE INFORMATION

Each site is assigned a number between 1 and 999 and a name. Each monitor is assigned a number between 1 and 999, usually corresponding to his or her site. Each monitor is encouraged to have a backup to monitor when the primary monitor is

Site Information Form

Press [F2] when complete.
Press [Esc] to abort data entry.

Sites # 2

Site Information Form

Site Number:	
Site Name:	
River:	
Primary Monitor Number:	
Backup Monitor Number:	
Date Begin:	(mm/dd/yy)
Date End:	(mm/dd/yy)
Parameters:	(Basic or Enhanced)
HUC Code:	
Water Body Code:	
Latitude:	(##:##:##)
Longitude:	(##:##:##)

unavailable. We just append the number with an A (for example, monitor 999A). At the Date Begin prompt, you enter the first date of monitoring. At Date End, you enter the date the monitor left the program. (Hopefully this slot remains empty.)

Under Parameters, the B is for basic tests, such as dissolved oxygen, pH, air and water temperature, clarity and salinity. E is for enhanced tests, such as nutrients. For the HUC code, you enter the eight-digit hydrologic unit code. The water body code requires a two-digit one letter code. Latitude and longitude are self evident. Once data has been input, press enter and then press F2 to save the information. You will then be back to the main menu.

Next you need to enter monitor information. To do so, you must choose Entry, Monitor(s), and the monitor information form appears. The form is self explanatory, requiring information such as name, address and monitor number. When you have completed the monitor information section, you can enter monitoring data.

Once the sheets have been sorted by river, collated by date, and checked for accuracy, you are ready to enter data. To do so, you must choose Entry, Monitoring Data, and the monitoring data form appears.

Monitoring Data Form

Press [F2] when complete.
Press [Esc] to abort data entry.

Monitoring Data Form

Monitor Number:
Site Number:
Collection Date:
Time of Day:
Monitor Name:
Site Name:
Air Temperature: C (Centigrade)
Secchi Depth: m (Meters)
Water Depth: m (Meters)
Water Temperature (Bucket): C (Centigrade)
Hydrometer Reading
Water Temperature (Hydrometer):
pH:
Dissolved Oxygen: Test 1: Test 2:
Avg: mg/l (ppm) Difference: (mg/l) (ppm)
Water Surface:
Weather:
Rainfall:
Other:
Range:
Water Color:
Comments:
Signature Present ?: Signature Date:

Nutrients
Ammonia: mg/l Range:
TN/TP sample #:

MONITORING DATA

The computer draws from the site and monitor databases and fills in the site number, monitor name and site name. It takes you to site number and won't let you enter any site numbers that haven't been entered in site information. The time of day is listed in military time, and the monitor and site names must be entered previously under monitorand site information.

The system has an expected response for specific parameters. For instance, with air and water temperatures, values between -6 and 46 are expected. If you don't enter the decimal place, you get an error message that indicates incomplete field. For secchi and water depth, values between zero and 10 are expected. For hydrometer readings, it won't accept a value greater than four, and pH is expected between zero and 11. For the first and second dissolved oxygen test, the program expects a value between zero and 20; if you don't enter the decimal place you get the error message (incomplete field). When you average the two tests, if your values are further than six-tenths apart, you get an error message at the end of the data entry session listing the entries in question.

At the more subjective sections, such as water surface, weather and water color, you enter numbers that correspond to various responses. For instance, if you enter 2 for water surface, the descriptive word "ripple" is inserted. If you enter 3 at weather, the descriptive word "overcast" is inserted. If you enter "N" at water color, it signifies normal conditions.

Under the comment section, monitors write brief statements to provide additional information, such as, "saw lots of SAV, celery weed, widgeon grass." Once completed, you press enter, then F2 to save the data and return to the main menu.

EDIT

If you need to change data, you use the edit function. Let's say you just entered a sheet, saved it

and then realized that you put in the wrong temperature. Choose Edit, Monitoring Data, Selected (You would get a list of all your sites here.) Choose the site number and indicate beginning and ending dates. If you have a lot of records and don't know the exact date you can put in a range here and use the page up and page down keys to find the record you need. Choose Q, the form is pulled up and you can use the enter key to move to the value you need to change. The edit mode is the only mode in which you can change data once it has been entered. Press F2 to save the change, choose Quit and you return to the main menu.

BROWSE

Once you have entered data, you can browse through it without disturbing it by using the browse function. Browse, Monitoring Data, Site (indicate site number) tells you exactly how many records you have entered. If you have lots of records, you can use the page up and page down keys to move through the data. You can use the enter key to move down through the form, but it won't let you make changes. Press F2 to exit and you're back at the main menu.

GRAPHS AND TABLE REPORTS

Let's say you want to send a graph report of dissolved oxygen and water temperature values to a monitor. Choose Reports, Individual, Data, Monitoring Data, Graphs, Exploratory. You enter the site number, the beginning and ending dates, and choose the variables (DO and water temperature) by moving to them with the arrow keys and entering. You'll see the number of variables chosen underneath. Then move to GRAPH and enter. The computer will flash "working" and then present a graph. Press enter and you can send it to the printer, create other graphs, or quit.

If you want to print the same information in a tabular form, choose Reports, Individual, Data, Monitoring Data, Tables, Basic, Selected, site number, beginning and ending date, Q. The computer will flash "working" and then the table will appear. Use the page down key to move. You can send the table to the printer, continue with other tables or graphs, or quit.

QUALITY CONTROL DATA ENTRY

You can enter data from a quality control session the same way you enter monitoring data. Press Entry, QC data and the QC Data Form appears. The only differences in QC data entry are the session number and replicate. Press Esc to get out of QC data form.

QC REPORTS

You can then create a graph or table report of QC data. Press Reports, Individual, Data, QC data, Graph, and the session number. Choose one variable and it is graphed. Send it to the printer, continue or press Q to quit.

INVENTORY CONTROL

You can keep track of your inventory using the Equipment Transaction Form. Press Entry, Equipment and the form appears. If you received a shipment, you type "R" for received at Transaction Type. If you are sending equipment to monitors, you would type "D" for disbursements at the transaction prompt. Once the amounts are completed, press F2 to save the data and you're back at the previous menu. Then you can create an inventory report. Press Reports, Individual, Equipment, Inventory, Screen and the Equipment Inventory Report gives you your totals.

MONITOR/SITE REPORT

You can also print out a full monitor/site report. Choose Reports, Individual; if you choose Brief the report shows by River: Monitor #, Site #, Monitor Name, Site Name, and Monitor Type. If you choose Full the report shows the full address. You can send it to the printer, continue with other reports, or Quit.

DATA APPLICATIONS AND PRESENTATION

Presenters: Jeff Schloss, University of New Hampshire, New Hampshire Lakes Lay Monitoring Program; and Jere Mossier, Idaho Division of Environmental Quality.

Jeffrey Schloss

University of New Hampshire

DATA PRESENTATION AND APPLICATIONS IN CITIZEN MONITORING

Presenting the results from your volunteer monitoring program to various audiences could be the key to your long-term success. Some may find themselves casually discussing the results of the year's sampling over a pot-luck dinner with monitors. Others may have to put on a multi-media blitz in hopes of protecting a resource or securing continued funding for their program. In either case, there are many presentation options and tools available for use.

Before monitoring even begins you should have planned for your data analysis and reporting based on program goals and objectives. Collecting the data first and worrying about the analysis later may prove disasterous. Plan for sufficient time to review data collected and process it into a summary presentation. Data users and your participants require proper feedback on a timely basis.

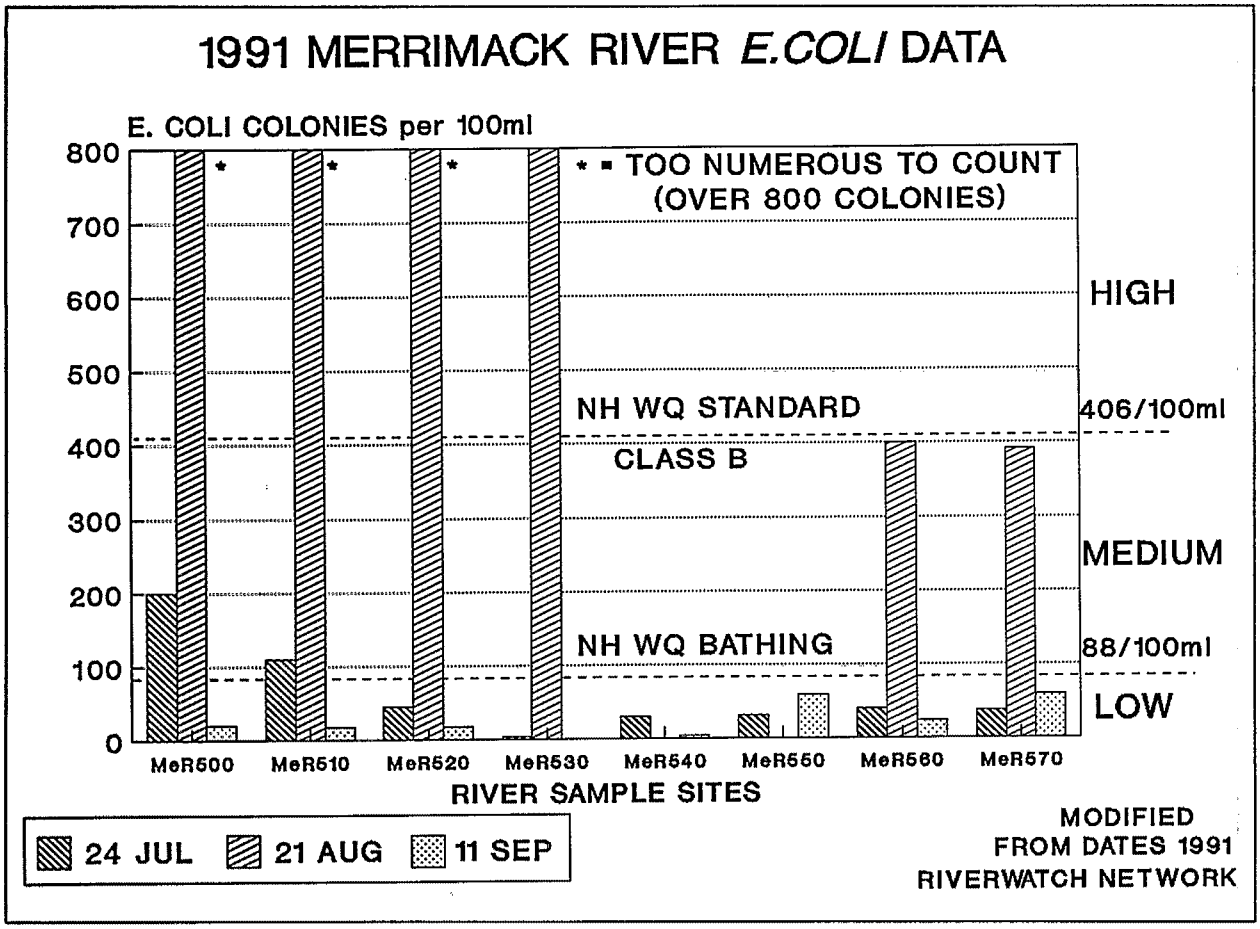
PROGRAM REPORTS

A report for seasonal or yearly data can take on many forms. For our program we try to make every report as complete as possible: An acknowledgement sections lists all volunteers and thanks those who provided assistance and funding. This is followed by a brief non-technical summary of the results and data analysis. Many of our participants use this section in their newsletters or in local press releases. The next section lists specific comments and recommendations for further monitoring. This is followed by an introduction which explains the reasons for monitoring, a short description of program goals and a program update. The next section provides an in-depth explanation of the measurements and the results. Graphs, figures and tables are included throughout to assist with explanations. Added to the end of the report are appendices that list data, a description of the field and analytical methods used and a glossary of important terms and concepts covered in the report. This assures that whoever might need to use the interpretations and data at a later time has all the necessary information to put these results into the proper perspective.

Budget, time or other constraints might limit your program reporting. In this case you might produce a companion interpretive and explanatory guide on a one-time basis that is updated as testing or processing methods change. The yearly reports can then refer to this guide for more detailed explanations of the program and a listing of the methods used. Always include some interpretative summary of the data in the individual reports. After devoting their time and interest to monitoring, your program participants need to feel that their efforts have made a difference in understanding or protecting the resource of concern. It is your job through reporting and presentation, to get this message across.

PRESENTING THE INFORMATION

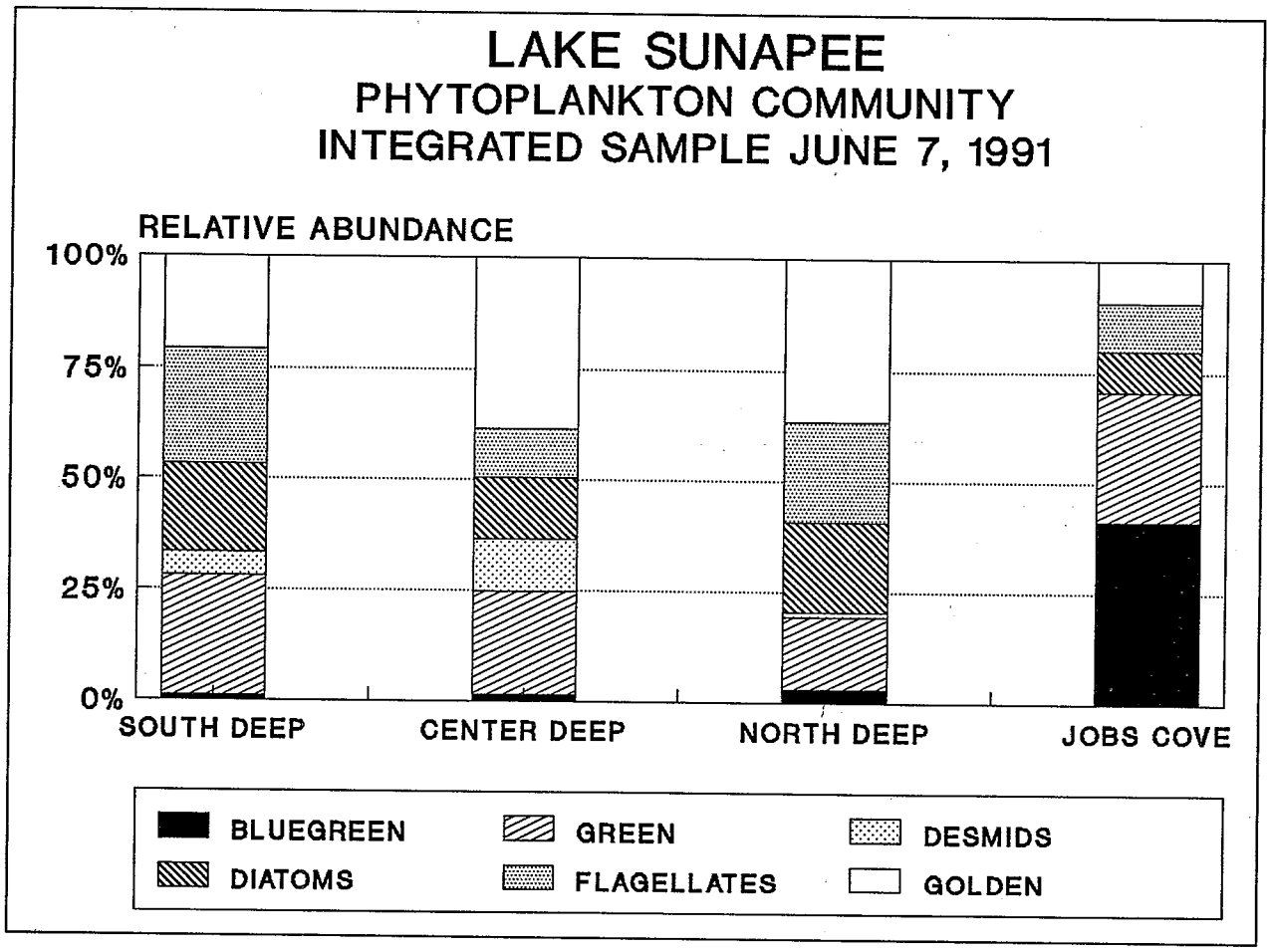
As professionals in environmental fields, we often tend to rely on specialized jargon. This makes communication within our field easier but often



adds an unnecessary level of complexity to the public. When presenting information from a lake study don't describe a lake as mesotrophic without covering the basics of the trophic classification scheme. Preface percent oxygen saturation data, common to river and coastal monitoring programs, with a brief background on temperature/oxygen relationships and acceptable levels for successful growth and reproduction of aquatic organisms important to the region. Put nutrient, chlorophyll (algae biomass), bacteria, and contaminant levels measured in perspective: What are acceptable concentrations? How do these levels compare to what is typical for the region? What are the standards set by local or state monitoring agencies? What constitutes a significant difference given the sampling methods, monitoring schedule and analytical techniques used? What are the limitations of these interpretations? The methods and details you use to deliver this information will often be determined by resource or time constraints. However, the choice of the appropriate method should involve careful consideration of the audience's expectations as well as an understanding of their knowledge base and interests.

FIGURES AND GRAPHICS

The worst type of feedback you can give to your participants, supporters and decision-makers is a lone data table. While listing data is required supporting material for a report, an appropriate graphical presentation of the information will always result in leaving a lasting impression of program results. For locational data, a map figure of the sampling locations with numbers or symbols that represent certain ranges of the sample results is a more useful



way to display the data. Many river and stream monitoring groups use this method (particularly for their bacteria results) but lake and coastal groups that sample many stations can also apply this technique. The bar graph is more commonly used, particularly for comparisons between dates or sites. A bar graph is a simple graph in which the height of a bar represents the measured value. Individual bars may represent a sampling site or the same site on different dates. While you need to be careful not to produce too cluttered a figure, the more interpretive information provided directly on the figure, the easier the explanation of the program results will be.

Many lake groups have made a small modification to the bar graph to produce a hanging bar graph of water clarity (secchi disk) results in which the base of the bar is at the top of the graph, representing the water's surface and the bar extends down to the water clarity depth. In some cases the bars are thin lines and there is a line or disk drawn at the bottom to represent the secchi disk.

Sometimes relative comparisons need to be made between sites. A stream monitoring program might want to compare the types of stream critters found, a lake program might have collected submergent vegetation data, a watershed watch group might have surveyed the area and determined the various sources of sediment pollution. To display these data a pie diagram or stacked bar graph is often used. Pie diagrams are more commonly used where each slice represents the relative amount of occurrence. In some cases the size of one pie relative to another is indicative of the total concentration or population measured.

There are many other types of graphs that may be useful: area graphs can display the accumulation of

data in an informative way; point and line, or scatter graphs may disclose trends over time; three-dimensional graphics tend to be more complicated to view but may be used successfully to illustrate some results. The choice of graphics is not as important as making sure the graph is easily understandable and complete with legend, keys and additional information that enhances the interpretation of the results.

With the advent of Geographical Information Systems (GIS), computer systems that integrate mapping capability with extensive database and modeling power, many new presentation options are becoming available. A pilot watershed study of the Squam Lakes, coordinated by the New Hampshire Office of State Planning using volunteer derived data from our program and other agencies, allowed for the production of maps (called coverages) that indicated current areas of water-quality concern, important in-lake wildlife resources habitat and the subwatershed areas that abutted these critical areas. As the power of a GIS system is related to the data it has to work with and given that volunteer monitoring programs represent a cost-effective way to collect these data, I expect to see new partnerships formed between the agencies and researchers that are acquiring this technology and citizen groups.

CLASSIFICATION, INDICES AND STATISTICS

Comparative research between different systems has yielded various numerical conversions and classification schemes that try to relate water quality or habitat condition to a limited set of measurements. Lake groups sometimes use a Trophic State Index that converts a water clarity, nutrient or algae (chlorophyll) measurement to a scaled number (usually 1 to 110). This makes comparisons and interpretations of lake productivity seem easier but care needs to be given in the interpretation of these results. This scheme assumes water clarity is dependent primarily on algae levels. There are some cases, however, where clarity is more dependent on sediment or dissolved color and the standard relationship breaks down. In addition, there are other lakes that are highly productive in submergent and emergent vegetation but have little algal growth. Thus while indices might be useful, knowledge of your particular system and regional conditions is paramount. Also, make sure you choose an appropriate classification scheme, one set up for seasonal averages might not be appropriate for a single measurement. When in doubt, contact your local or regional environmental agency or university.

Stream monitors have led the way with the use of diversity indices and indicator organisms schemes. Current methods are related in one way or another to the EPA Rapid Bioassessment Protocols or specific regional research. It is generally much easier to relate information of presence or absence of macroinvertebrates than to rattle off numbers representing nutrient, pesticide or bacteria levels. In presenting these data, stacked bar graphs of the types of organisms or a line graph of the index or ratio change from station to station are appropriate tools to enhance the message.

As a final note, I would like to emphasize that the systems, software and hardware to produce presentations and reports might be more available than you think. While your local, regional and state agencies quickly come to mind, don't forget about schools, colleges universities and local businesses. For instance, a neighborhood group on Flint Pond in New Hampshire conducted a survey to map the lake and determine the accumulation of bottom material. With no previous experience and using one of the member's personal computer and CAD/CAM software, the final result was a professional quality map of the lake and an accurate estimation of bottom material accumulated. These do-it-your-selfers brought the information to their town and the state environmental agency, and this year the lake will be under further study due to acceptance into the federally funded Clean Lakes Program.

Jere Mossier

Idaho Division of Environmental Quality

IDAHO'S VOLUNTEER PROGRAM

Idaho's Citizen Volunteer Monitoring Program (CVMP) currently involves nine lakes, with two more to be added in 1992. The CVMP lakes include: Pend

Oreille, Hayden, Priest, Spirit, Cocolalla, Hauser, Rose, Upper Twin and Lower Twin Lakes. Coeur d'Alene and Fernan Lakes are the lakes to be added.

Eight of these lakes were also studied in a Lake Water Quality Assessment (LWQA) Project over the last two years. The Lake Water Quality Assessment Project was conducted by the Idaho Division of Environmental Quality (DEQ) on 17 lakes in Idaho during 1990-1991. The final LWQA report will be available in June 1992.

The objectives of the LWQA Study were to:

1. Determine trophic status;
2. Assess trends where possible;
3. Q.A. our Citizen Volunteer Monitoring Program;
4. Determine beneficial use support status;
5. Determine nutrients of concern;
6. Identify sources of pollution, and;
7. Recommend appropriate management actions.

The water quality and biological data and information from both the CVMP and the LWQA programs have been integrated to develop more accurate and reliable methods to assess water quality and trophic status in lakes. The integrated findings of these two projects are discussed below.

The general water quality and trophic status of each lake was determined by using secchi depth, chlorophyll a, the prevalent submergent and floating-leaf macrophyte species, the maximum depth of submergent plant growth, the maximum hypolimnetic total phosphorus and total ammonia, and the minimum hypolimnetic dissolved oxygen and dissolved oxygen/temperature profiles. Each lake is classified as eutrophic, mesotrophic or oligotrophic based on the collective numerical values and best scientific judgement related to the status of the lake.

Submergent macrophyte communities provide an excellent means of studying and monitoring changes in the trophic status of lakes. In the summer of 1991, we decided to incorporate an effective and efficient way to determine the water quality and overall condition of the 17 Idaho lakes by determining the number of prevalent species in submergent macrophyte communities. The number of prevalent submergent and floating-leaf macrophyte species is defined as those species found in at least 25 percent of the lake. The diversity of prevalent species generally demonstrated a twofold increase from eutrophic to mesotrophic to oligotrophic lakes. That is, oligotrophic lakes have approximately four times the number of prevalent species compared to eutrophic lakes. Mesotrophic lakes have twice the number of prevalent species found in eutrophic and half the number of prevalent species found in oligotrophic lakes.

The number of dominant submergent macrophyte species varies in different lakes. This is mainly due to the ubiquitous nature of some submergent macrophyte species and the masking effect of interacting factors affecting submergent macrophyte distribution and abundance. These interacting factors include: water depth and clarity as related to light availability, metal toxicity and nutrient levels, lake bottom substrate type, wave action, especially in the shallow littoral areas, and dissolved oxygen and temperature extremes and averages.

The dissolved oxygen/temperature profile, along with chlorophyll, were determined to provide a broader database to assess lake conditions and achieve the study objectives. Secchi depth and lake trophic status demonstrate a strong positive relationship and consequently provide a useful basis to evaluate the water quality conditions of a lake. The number of prevalent species in relation to secchi depth and trophic lake status appear to be an extremely reliable and cost effective means to assess lake trophic status. Secchi depth and the maximum depth of submergent aquatic plant growth are positively correlated ($r=0.83$) as would be expected. This provides further support to the premise that submergent macrophyte communities should be used as biological indicators in assessing lake trophic status.

The trophic status of freshwater lakes is best determined by using both water quality and biological indices as measurements of lake productivity. Secchi depth, chlorophyll and total phosphorus are traditionally used as the primary parameters in evaluating lake trophic status. These measurements were used along with various analysis of the submergent and floating-leaf macrophyte lake communities, as

Table 3. A list of sampling parameters and sampling frequency of 24 Idaho Lakes proposed for FY 92 & FY 93 Lake Water Quality Assessment (LWQA) and Citizen Volunteer Monitoring Program (CVMP). *

Sampling Parameter	Sampling Frequency	Sampling Program
Chlorophyll "a"	4 times/year	composite trophogenic or 2 @ secchi depth
Secchi Depth	4 times/year	one for small lakes, 2–3 for larger lakes
Total Phosphorus	4 times/year	one each in the hypolimnion & epilimnion
Fecal Coliform Bacteria	4 times/year	1–3 in the epilimnion and/or littoral zone
Total Hardness	4 times/year	one in the epilimnion
Alkalinity	4 times/year	one in the epilimnion
pH Profiles	4 times/year	lake surface to lake bottom
Sp. Conductivity Profiles	4 times/year	lake surface to lake bottom
D.O./Temperature Profiles	4 times/year	lake surface to lake bottom
Submergent Macrophytes	1 time/year	to maximum water depth of plant growth

* This Table lists the sampling program for 1992 only. The sampling program for 1993 will be modified as needed based on preliminary data analysis.

well as maximum hypolimnetic ammonia and maximum hypolimnetic total phosphorus. Minimum hypolimnetic oxygen and dissolved oxygen/temperature profiles for each lake at the peak of the growing season (August) were used extensively in determining the lake trophic status.

The rationale for using submergent macrophytes and water quality measurements to determine trophic status is as follows: Submergent and floating-leaf macrophytes form associations of communities in lakes which are indicative of the water quality. As mentioned earlier, prevalent species of submergent and floating-leaf macrophytes were defined in this study as those species which occurred in approximately 25 percent of the areas sampled in a lake. The word prevalent is used rather than dominant or significant and implies that collectively, these species represent a specific water quality status or trophic status. Submergent macrophyte communities have environmentally dependent successional patterns with changing water quality conditions. Consequently, one can speculate that the community composition of the macrophyte community will change as the toxic and/or nutrient water quality conditions change. Since submergent and floating-leaf macrophytes are found in the lake throughout the year, their study and analysis provides a basis to evaluate lake eutrophication and detect water pollution.

Water clarity (indicated as secchi depth) can be a function of many factors, both biological and environmental. Algal blooms, lignins and tannins, wave action and both point and nonpoint discharges will affect the amount of suspended solids, toxins and nutrients in the lake. Seasonal turnovers in the spring and fall further recycle bottom sediments and nutrients throughout the lake. The angle and intensity of sunlight further affects the lake water clarity. Nevertheless, secchi depth is still considered an efficient and effective means to determine water clarity. Secchi depth is positively correlated to the maximum depth at which rooted aquatic plants can grow in a lake, since light penetration in a lake is critical in determining the distribution of submergent macrophytes.

Secchi depth and lake trophic status are interrelated; secchi depth increases from the most eutrophic lakes (Winchester = 1.0 meter) to the most oligotrophic lake (Priest Lake = 11.0 meters).

Conversely, chlorophyll productivity was found to be the highest of all CVMP/LWQA lakes studied (21.1 ug/L) in hyper-eutrophic Winchester Lake, while oligotrophic Priest Lake was the lowest at 1.0 ug/L. The four oligotrophic lakes, including Priest, Hayden, Spirit and Upper Priest, showed very low chlorophyll production. Other lakes in the study, such as Mann and Waha lakes, showed low chlorophyll production. However, this was due to the extreme drawdown and fluctuation in the water level. This is a very significant factor distorting the true phytoplankton production throughout the year. The drawdown also has a major, limiting-impact on the submergent aquatic plant communities in these lakes.

One of the problems of using chlorophyll "a" values as an index of trophic status is the variability and pulsing of blooms that occurs irregularly, especially with the blue-green algae groups. Submergent and floating-leaf macrophyte communities are reliable long-term indicators of productivity in lakes. These macrophyte communities fluctuate less in species composition on a seasonal and year-to-year basis than phytoplankton populations.

Generally speaking, the species diversity of submergent macrophytes is significantly higher for oligotrophic and mesotrophic lakes than in late eutrophic lakes. Hyper-eutrophic lakes (Winchester) and lakes that experience frequent drawdown and fluctuating water levels (Mann, Waha, and Soldier Meadow) may have few or no submergent macrophytes. Furthermore, the use of prevalent species, rather than species diversity is a more reliable indicator of lake trophic status.

The maximum depth at which submergent aquatic plants grow is positively related to the water clarity and trophic lake status. Hence, submergent macrophytes grow deeper in oligotrophic lakes than eutrophic lakes.

Maximum hypolimnetic phosphorus in hyper-eutrophic lakes is much higher, compared to phosphorus found in oligotrophic and mesotrophic lakes. The conditions in the deep hypolimnion near rich organic lake bottoms are enriched by decomposition of extensive blue-green algae blooms and other organic matter. This contributes significantly to the internal recycling of phosphorus in the lake.

Maximum hypolimnetic ammonia does not appear to be as good an indicator of lake trophic status as phosphorus. However, high ammonia levels in the hypolimnion near the lake bottom are very evident in lakes with anaerobic or anoxic hypolimnions such as Winchester and Granite Lakes. Hypolimnetic ammonia levels were not significant in the four oligotrophic lakes.

The minimum hypolimnetic dissolved oxygen is significantly higher in all four oligotrophic lakes relative to the mesotrophic and eutrophic lakes studied. The only exeptions were Upper Twin and Mann Lakes, which did not thermally stratify due to their shallowness and exposure to strong winds. Consequently, these two lakes cannot be compared to the four thermally stratified, deep oligotrophic lakes. The presence or absence of ample dissolved oxygen in the deep hypolimnion in late summer is a critical limnological and useful measurement as related to lake trophic status.

Dissolved oxygen/temperature profiles for the 17 lakes studied in the Idaho Lake Water Quality Assessment (LWQA) Project and the Citizens' Voluteer Lake Monitoring Program (CVMP) provided some of the most reliable and useful data and information in assessing the trophic status and water quality of lakes.

MEETING SCIENTIFIC STANDARDS FOR BIOLOGICAL MONITORING

Presenters: Loren Kellogg, Izaak Walton League of America's Save Our Streams Program; and Wayne Davis, U.S. Environmental Protection Agency, Region Five.

Loren Kellogg

Izaak Walton League of America

COLLECTING QUALITY DATA

The Izaak Walton League of America's Save Our Streams (SOS) Program is a grassroots river protection and restoration program that has been active for 22 years in over 37 different states. SOS provides volunteers with a simple but effective way to monitor their watershed using a biological approach. There are thousands of active participants across the United States who use SOS to provide personal stewardship to their rivers.

Currently Save Our Streams has state-sponsored programs in Virginia, West Virginia and Tennessee. Each of these programs have quality assurance/quality control (QA/QC) guidelines which define our data-quality objectives, training procedures, monitoring protocols, monitoring support systems and performance audits, as well as macroinvertebrate identification tests for evaluating data reliability.

As an initial step in any monitoring program, a clear and defined purpose should be established for data use. This should be done through close communication with the people who will potentially use your data. Data should fill a specific need (gap) or intent (hypothesis testing, study objectives). By working closely with data users, clearly identifying your data-quality objectives and designing your program to produce data of known quality that meet these objectives, you increase the likelihood that your data will get used.

When planning a program, remember that as data-quality objectives become more stringent, more money and resources will be required to meet those objectives, and in general your program will become more restrictive.

The reason most frequently identified for not using volunteer data is lack of confidence in data quality (US EPA, 1990a). A QA/QC program requires careful documentation and implementation of every aspect of monitoring procedures. This program has two functions: first, to continually monitor the reliability of the data (accuracy, completeness, representativeness) and second, to make sure the data meets the program requirements (US EPA, 1990b). This requires a continuous program of monitoring your monitoring, and evaluating and quantifying the error involved in the data-gathering process. With a thorough and demonstrable QA/QC program, you maximize use of your data.

The biological monitoring component of the national Save Our Streams program uses a kick-seine net to trap stream macroinvertebrates which are then identified to the family or order level. This technique is based on the finding that different groups of stream macroinvertebrates have different tolerances to pollution and can serve as useful indicators of water quality. Our surveying technique includes a number of questions about stream condition and habitat suitability which together have been shown to be a reliable and inexpensive way to indicate stream health.

The SOS training program can be divided into four main parts: initial training sessions, support networks, field spot checks and follow-up workshops. Our initial training workshops last about four hours. We start with a lecture accompanied by

slides, in which we introduce the biological monitoring concept, basic macroinvertebrate identification, identification of monitoring sites for testing impacts and the stream survey design. The next section of the training is spent out in the stream. Participants are instructed how to identify a riffle and shown exactly how to carry out the SOS sampling technique.

To take a sample, volunteers place the net in a riffle area (facing upstream) and secure the bottom of the net with rocks in front of the net. Volunteers then rub the rocks thoroughly in a three-foot by three-foot-square area. When the first two inches of substrate have been completely disturbed, the sample is removed from the stream in a forward sweeping motion (so the organisms don't fall off) and carried to the stream bank.

Organisms are placed in magnifier boxes and given to workshop participants for identification. Workshop participants are instructed in identification techniques such as counting number of legs, identifying gills, antenna, segmentation, size and behavior characteristics including preferred habitat and movement. Each participant observes and identifies every organism found. Materials, such as the stream insects and crustaceans card which depicts and explains stream organisms, are provided to aid in identification. In addition, resource lists of macroinvertebrate identification aids, numbers of regional and local SOS coordinators and resource materials are available.

The group is taught to rate stream quality using the Save Our Streams Survey Chart. The survey uses species richness and a point system which assigns higher points to more pollution sensitive organisms (stoneflies and mayflies) and lower point values for pollution tolerant organisms (black fly larvae and aquatic worms) to rate stream health. A final index rating for the stream of excellent, good, fair or poor is determined using instructions on the survey sheet.

Because of the thorough rubbing of all rock surfaces and the meticulous disturbance of all bottom substrate within the sample area, we get organisms representative of all major microhabitats within the riffle area. This is evidenced by the presence of leaf packs, sticks and all the major groups of organisms (shredders, scrapers and filterers) in most of our samples. Also, all of the macroinvertebrates caught are used in the sample (eliminating sample bias), and all are identified to order level as required in EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish.*

In our initial training workshops, a standard bug library is used to teach participants how to identify all groups of organisms that are found regularly in a riffle area and used on our survey form. In addition, we have follow up workshops (as detailed in our QA/QC guidelines) six months after our initial trainings. These workshops are designed to accomplish three things: First, to address any questions monitors may have. It is an opportunity to refresh participants on the resources of the program, and introduce them to other monitors in the area. It also gives us a chance to inform participants of any changes in the programs (biological monitoring is an evolving science).

Second, we evaluate our monitors by organizing small groups and watching them stream monitor. This evaluation is more subjective than our spot checks; it is intended to provide a quick check for potential problems. Next is a formal test of macroinvertebrate identification skills. Monitors are allowed to use any materials they normally have in the field to identify test organisms from all the groups in our reference collection. These tests are scored and reports are used to evaluate the accuracy of data at each monitoring station.

Part of our QA/QC is to spot check 15 percent of our monitors. This is done by national and regional staff. It works by calling up a monitor (or group) and making a date to monitor. At this session we simply observe the whole process from riffle identification to the finished survey results, then we offer suggestions to improve monitoring technique (if applicable) and make a written evaluation. These evaluations are included in our files and submitted regularly with our data.

Each of our state-sponsored programs is tailored to complement the resources and support capabilities available for volunteers in the respective state.

Virginia, West Virginia and Tennessee all have in-state support networks of people, information and materials in place to help monitors get the most accurate picture of water quality possible. In addition, monitors can contact the League's national office for assistance.

Survey accuracy is determined by reviewing a number of questions on the survey form which assist SOS staff in determining if results are correct. For example, if trout are known to be in the stream, yet results indicate poor water quality, the survey results are questioned. If the riffle is classified as "80 percent mud," an improper location was selected and results are not considered accurate for this technique. (We do have an approved muddy bottom sampling technique.) Also, answers to questions like "sample number" demonstrate that a monitor knows to take the most diverse of the three samples.

If survey results are inconsistent (poor results in a known trout stream), have problems (not in a riffle) or just have poor results, SOS staff contact the monitor for specific information. If the problem seems to be due to monitor error, SOS staff schedule a time to monitor with the volunteer to make sure proper procedures are being followed. When inconsistencies are justifiable or problems are indicated, the appropriate regulatory agencies are notified.

Once data is checked, the survey is entered exactly as it was submitted (including all comments) onto a Dbase III+ program called Bugs. Data is distributed to state agencies on disks for their evaluations. Also, reports are generated, and results are interpreted based on physical and biological assessments, land-use evaluations, comments and comparisons with known yearly fluctuations of macroinvertebrate recruitment cycles from similar hydrologic areas (reference sites).

Volunteer biomonitoring data can play a crucial role in the assessment of surface waters. Open communication about monitoring QA/QC with the federal, state and local persons who accept volunteer data will improve data acceptability. Programs with an emphasis on well-defined monitoring procedures that correspond to standard biomonitoring methods will result in improved data confidence and increased use of volunteer data.

REFERENCES

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughs. 1989. Rapid Bioassessment Protocols For Use In Streams And Rivers, U.S. Environmental Protection Agency, Office of Water, Washington D.C. 20460 EPA/440/4-39-001

USEPA. 1990b. Volunteer Monitoring: A Guide for State Managers. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. 20460 EPA/440/4-90-010

USEPA. 1990a. Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters, U.S. Environmental Protection Agency, Office of Research and Development, Washington D.C. 20460 EPA/600/4-90-030

Wayne S. Davis

U.S. Environmental Protection Agency, Region Five

USING AN INTEGRATED APPROACH

For more than 100 years freshwater benthic macroinvertebrate (benthos) communities have been associated with a variety of environmental conditions and are excellent indicators of the quality of a water resource. Benthic macroinvertebrates are relatively sedentary organisms that inhabit or depend upon the sedimentary environment for their various life functions. Therefore, they are sensitive to both long-term and short-term changes in habitat, sediment and water quality. Whereas chemical and toxicity testing generally use a grab-sample approach and are specific to assessing effects based on the chemicals analyzed or toxicity, benthos can be used to detect impacts from a variety of causes, including siltation, nutrient enrichment, low dissolved oxygen and overall habitat degradation.

Determining the quality of a surface-water resource is best accomplished in conjunction with an integrated approach which also utilizes habitat quality, water and sediment chemistry, water and sediment toxicity. This paper outlines the necessary scientific methods (quality assurance needs) to ensure that biological monitoring using benthic

macroinvertebrates meet minimum standards for acceptance by federal, state, interstate and local governments, as well as other intended users.

DEVELOPMENT OF BIOLOGICAL CRITERIA

The primary way surface waters have been assessed for pollution is by comparing water-sample results with chemical criteria and/or standards. Water quality standards are adopted in state law and comprise: a designated beneficial use of the waterway, numerical and narrative criteria established to protect that use, and an antidegradation statement. A major beneficial use of a waterway is for protection of aquatic life and is usually based on the quality of habitat that should be present. Minimum habitat quality exists below which the benthos community will perform poorly regardless of the chemical contaminants present or not.

EPA initiated efforts towards development and implementation of biological criteria based upon benthic macroinvertebrate, fish and habitat assessments. These biological criteria, which have been predominantly based on macroinvertebrates, are designed to determine whether a specific waterbody or segment is meeting its designated beneficial use for aquatic life (water quality standards).

OVERVIEW OF BASIC PROTOCOLS

The benthic macroinvertebrate community structure and function assessment involves the following key steps and subsequent decisions which are addressed in USEPA (1990), Klemm et al. (1990), USDA (1989) and/or Plafkin et al. (1989):

1. Establishment of data-quality objectives and a quality assurance program plan cooperatively developed with local and/or state governments;
2. Collection of benthic macroinvertebrates in the field and whether: (a) artificial or natural substrates are used, (b) quantitative or qualitative sample methods are used, and (c) single habitat (riffle) or multiple habitats are sampled;
3. Preservation and/or fixation of the benthos (field and laboratory) or return of the benthos in the field;
4. Sorting the organisms from debris (field or laboratory), selection of mesh size for sorting, and whether special aides are used (rose-bengal stain or a sugar solution);
5. Identification to the lowest taxon necessary (varies depending upon the study objectives) which should be applied consistently throughout the study;
6. Establishment and maintenance of a voucher collection of benthos from the study area(s) to be available for program education and to ensure proper identification has occurred;
7. Multi-metric or composite index quantification (taxa richness, number of individuals, indicator organism count, structural indices and ratios, functional characteristics of taxa);
8. Assessment of the relationship with other environmental measurements including numeric habitat quality assessment (correlations, habitat requirements) and expectations;
9. Comparison of results with a local or regional reference site (similarity indices, nonparametric analyses);
10. Complete documentation of the study methods, results, database management and discussion of the relevance of the data.

HABITAT ASSESSMENT

A habitat assessment and other physico-chemical observations are critical to evaluating the meaning of the data collected. The habitat assessment will help determine the extent of the results due to habitat quality, rather than just due to chemical/physical disturbances. Habitat assessments are sometimes divided into three categories: primary, secondary and tertiary. The primary parameters most directly influence the results found and include characterizing the substrate, flow or velocity, stream cover and depth. Secondary parameters measure larger habitat features such as channel alteration, and tertiary parameters evaluate riparian and bank structure. Plafkin et al. (1989), Rankin (1989), and USDA (1989) discuss basic numeric habitat assessments.

QUALITY ASSURANCE NEEDS

To ensure as much accuracy and precision in the data as possible, a detailed quality assurance program plan should be established and followed. Careful and consistent field and laboratory protocols are necessary. It is also necessary to sample during optimal conditions, which can minimize the effects of natural variations in the data. Specific QA procedures that should be established early in benthic macroinvertebrate community studies include the following:

- Rationale for sample location selection and time of sampling;
- Sample collection methods, sorting and storage procedures;
- Taxonomic proficiency evaluations using check samples (from Cincinnati-ERL or other sources), in addition to voucher collections from each study area and a list of the taxonomic references used;
- Multi-metric data analysis techniques used to objectively assess the data, including the structural and functional measures.

Each Regional U.S. EPA Quality Assurance Office can provide the details of QA procedure requirements. Detailed discussion of quality assurance measures can be found in Klemm et.al (1990), USEPA (1990), USDA (1989) and Ohio EPA (1989).

RAPID BIOASSESSMENT PROTOCOLS (RBPs)

U.S. EPA developed a framework and protocols for conducting cost-effective benthic surveys of wadable streams and rivers. There are three levels of protocols for benthos based upon conducting single-habitat (riffle) dip-net sampling and the level of effort to be expended in the field for collection and identification. RBP One is for screening studies and uses a similar level of effort as some volunteer programs which identify benthos to order or family. RBP Two is slightly more intensive and relies upon family-level identification which could be completed in the field, and utilizes numeric data analysis techniques. RBP Three is even more intensive and requires laboratory identification of the benthos usually to genus/species for more rigorous data analysis. The results for RBP Two and Three are expressed in a composite index using the following two functional and six structural metrics: (1) Taxa richness, (2) Modified Hilsenhoff biotic index, (3) Ratio of scrapers and filtering collectors (functional), (4) Ratio of EPT and Chironomidae abundances, (5) Percent contribution of dominant taxon, (6) EPT index, (7) Community similarity index, and (8) Ratio of shredders to total number of organisms (functional).

The scores are based on a percentage of the metric values found at a reference site, rather than comparison of the results based on optimal values for each metric. The RBPs are flexible and can be modified for different geographical locations. The success of the RBPs is in the use of the composite index for rapid assessments that allows for three levels of taxonomic work (order, family or genus/species levels). Order and family taxonomy do not require laboratory taxonomy and may be done in the field. The RBPs normally use single habitat (riffle) sampling and a 100-organism count in the field. However, they can be adapted for most program uses; for example, by employing multi-habitat sampling and/or various count limitations.

DATA INTERPRETATION AND ANALYSIS

One of the most inconsistent and perplexing aspects of a freshwater benthic macroinvertebrate community assessment is the numeric representation and analysis of the data collected. Structural community measures such as richness values (number of taxa), diversity and biotic indices, and enumerations (counts of individual organisms) have been used almost exclusively. Indicator organisms have been used to establish many of the biotic indices but also have the potential to differentiate among types of impacts. Recently, functional community measures based on feeding groups such as shredder, collector, scraper and predator have gained wider application and acceptance due to their sensitivity in detecting system perturbation on food resources. It is strongly recommended that a multi-metric technique be used (Plafkin et al. 1989), Ohio EPA (1990) so any *single* measurement or observation will not substantially influence the results.

REFERENCES

Klemm, D.J., P.A. Lewis, F. Fulk, J.M. Lazorchak. 1990. Macroinvertebrate Field and laboratory methods for evaluating the biological integrity of surface waters. USEPA, ORD, Cincinnati, OH, EPA/600/4-90/030. 256 p.

Merritt, R.W., and K.W. Cummins (eds). 1984. An introduction to the aquatic insects of North America. 2nd edition. Kendall/Hunt Publ., Dubuque, IA. 441 pp.

Ohio Environmental Protection Agency. 1990. The use of biocriteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio 43212.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughs. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. USEPA, Office of Water, Washington, D.C. EPA/440/4-39-001.

Rankin, E.T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio 43212.

U.S. Department of Agriculture. 1989. Fisheries Habitat Surveys Handbook (R-4 FSH 2609.23), Forest Service Intermountain Region, Ogden, UT.

U.S. Environmental Protection Agency. 1990a. Biological criteria: national program guidance for surface waters. USEPA, Office of Water, Washington, D.C., EPA-440/5-90-004.

U.S. Environmental Protection Agency. 1990b. Volunteer Water Monitoring: A Guide for State Managers. Office of Water, Washington, D.C. EPA-440/4-90-010.

STUDY DESIGN

Presenters: Anne E. Lyon, Tennessee Valley Authority; Jack Byme and Geoff Dates, River Watch Network.

Anne E. Lyon

Tennessee Valley Authority

STUDENTS STUDY WATER QUALITY

When the Tennessee Valley Authority (TVA) created the Teacher/Student Water Quality Monitoring Network in 1986, the primary goal of the program was to gather basic water quality data from small streams and lakes that TVA personnel were unable to monitor. But the program also spawned several other objectives, including getting water quality management concepts into the valley's secondary school curricula and providing enhancement opportunities for both teachers and students. Unlike other water monitoring programs throughout the United States, the focus of this program is to train teachers and students to conduct real water-quality studies. Instead of having the participants collect standard information and supply it to TVA, they are taught to develop a study question, select the appropriate measurements to answer the question and interpret the data. TVA receives a research paper on the study which is then published in a yearbook and shared with other researchers.

This program is funded with federal appropriated funds for surface water monitoring and sponsored by TVA's Water Resources Division. TVA's Water Quality and Environmental Education staffs work with the Center for Environmental, Energy and Science Education at the University of Tennessee at Chattanooga to conduct the program. The network is comprised of 24 science teachers from grades nine through 12 who teach within TVA's seven-state service area. Teachers selected are given the opportunity to actively participate for up to three years. Each year eight new teachers are selected to replace participants who have completed the program. New teachers are selected on the basis of applications which detail their educational background, experience in water quality and environmental research, and their proposed area of study. The teachers who complete three active years in the program are encouraged to continue their work and supply TVA with the results in exchange for a budget for chemicals and supplies.

Each fall, 24 active teachers participate in a two and one-half day workshop, where they learn about chemical, physical and biological parameters of water quality. Each teacher is invited to bring two students to participate in an intensive workshop, which covers information on ecosystems, watersheds, water chemistry, hydrology, aquatic biology, water quality management, study design and field safety. We make sure that every lecture during the workshop is a mixture of both knowledge and practical applications. We also instruct participants on how to read topographic maps, use keys to identify aquatic invertebrates, and conduct water chemistry analyses in the field.

Each teacher is given a TVA-customized LaMotte Chemical Kit that enables them to measure parameters such as dissolved oxygen, nutrients, pH, hardness, alkalinity and chlorides. We teach them how to use stream sampling equipment and collect data using the Izaak Walton League's Save Our Streams Data Sheet. We also teach them how to design a study.

By the end of the workshop, each teacher/student team has a draft design of the study they will

conduct at their field site the following spring. We even teach them how to write a journal article using the data they collect and how to develop a poster session. To provide follow-up support, TVA's Water Quality and Aquatic Biology staffs are available to evaluate the study designs, make suggestions and help interpret the findings. Results of the field studies are written in journal article format and reviewed by TVA and University of Tennessee professionals. The articles are published in a Teacher/Student Water Quality Monitoring Network Yearbook.

TVA conducted field tests on materials and standardized our fall workshop series, which enables us to provide teachers in the program with a complete guide they can take back to their classrooms. The guidebook was prepared over a three-year period using evaluations conducted at the conclusion of each workshop. Based on our experiences, we determined a basic understanding of the water cycle and how water moved was necessary. From here, we make the connection between land use and water quality. How does water become polluted and with what? And how do we determine if water has become contaminated? To do this requires a basic understanding of water chemistry—water quality variables.

We teach water quality variables by showing the relationships between these variables and associating them with the chemical tests participants perform with their kits. We stress that chemical measures are only one way to look at water quality, but that a comprehensive water monitoring program looks at the big picture. For that reason, TVA conducts routine chemical tests: fecal coliform analyses; aquatic life inventories such as algae, fish and invertebrates; bioassays using sensitive organisms such as fathead minnows and juvenile mussels; and fish health assessments. Water quality is determined by looking at the results of all of these measures together.

Understanding and being able to use the chemical test kit is essential, and participants receive instruction in the lab and field on how to conduct four basic tests: dissolved oxygen, total alkalinity, calcium and total hardness, and chloride. If time permits, other tests such as nitrates, ammonium, iron, manganese, and phosphates are taught.

We also teach participants how to use a dichotomous key to identify the specimens they collect. They learn to recognize certain invertebrates by sight using features such as the presence of two or three tails to distinguish stoneflies from mayflies. They also learn to use a variety of homemade sampling equipment and are given instructions on how to make a set. In the field, they learn how to use a kick net and the Izaak Walton League's Data Form to measure stream quality.

Participants are taught to determine streamflow using an apple or orange, two marker sticks, a yardstick, a 50-yard measuring tape, a watch with a second hand, a calculator and a formula. We stress that all data sets need certain pieces of information. In fact, if they can only collect three measures, we suggest temperature, dissolved oxygen and streamflow.

We teach them how to use both standing and moving seine techniques to capture fish. TVA biologists identify the fish, and by the end of the workshop most participants can identify a few common species. The numbers and types of fish in a stream is another important indicator of water quality. Participants learn that even if they can't identify the fish, they can count the number of fish and compare this with previous collections. Most states require permits to collect fish and/or invertebrates, so we provide information on how to obtain these permits.

In order to conduct a quality study, we recommend they start small and work up to larger projects. We emphasize that they should ask a question they can answer. When they have come up with a question, TVA professionals work with participants to determine what types of information they will need to answer the question, and how many sites and how often samples should be collected. This becomes the basis for their study design.

The final portion of the workshop stresses interpreting the data and putting it in a form useful to others. Participants are given data sets to evaluate and information on how to determine what is a normal value using their test kits. But data is useless

unless it can be communicated to others, so we teach them how to write up their results in a manner that will be useful to other professionals in journal writing style. We also teach them how to construct useful tables and charts, and suggest developing poster sessions.

To get educators to teach water quality concepts to students once they return to the classroom, we provide an activity guide including background notes, materials lists, procedures, discussion suggestions, references and information on how to obtain the materials necessary to conduct the activity. Teachers are comfortable teaching activities they participated in during the workshop, and the guide makes it easier to duplicate in the classroom. We also took special care to make the activities fit into existing classroom schedules.

The result of these efforts, the *Fall Workshop Teacher's Guide*, contains all the information covered at the workshop. It includes our workshop agenda, a list of reference materials, lecture notes and overhead masters. Complete activities with answers and explanations, handouts, data sheets, and student activity sheets are also included. Teachers attending our workshops receive a copy of this guide. It is also available for other groups interested in starting a similar program in their area.

In the past six years, more than 60 teachers and 150 students have participated directly in the program. One teacher got his community so excited about his classes' work with the network that they built him a new high school laboratory. Since he was a chemistry and biology teacher in a rural school with no laboratory, this lab enabled him to develop a challenging new science program at his school. One eastern Tennessee teacher and his class did a study on a local stream and decided to start a cleanup campaign. They received permission from local landowners along the creek and completely cleared all the litter from its banks. Another teacher/student team studied agricultural runoff on their river and alerted a farmer about the effects his livestock were having. They convinced the farmer to build a fence to keep his cows from grazing along the streambank. Still another team got involved with an abandoned mine site. Through their study, they were able to show the effects acid mine drainage was having on the stream and use this information to convince state officials to remediate the site. They are currently monitoring the positive effects remediation has had on the stream.

But the real value of the program has been to TVA. These teacher/student teams have provided valuable baseline data on streams TVA is currently unable to monitor. They have alerted the agency to situations which may have gone undetected for years. More importantly, the program has gotten teachers, students and the communities excited about water quality. Involvement is the key, and that's what the Teacher/Student Water Quality Monitoring Network is all about. After all, our future and the future of generations to come, will be directly affected by the quality of our water resources.

FOR MORE INFORMATION:

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Jack Byrne and Geoff Dates

River Watch Network

DESIGNING A WATER QUALITY STUDY

Before we get into how to do a study design, we need to put it in the context of organizing a river monitoring and protection program. River Watch Network provides organizational, technical and training assistance to groups and schools that wish to monitor and protect their rivers. We typically work with a number of organizations and agencies to develop and carry out these programs. River studies

undertaken by citizen groups and schools we work with include:

- A River Characterization Study, which establishes baseline information on the river's physical, chemical and biological characteristics. Visual information, field measurements, water samples and aquatic-life samples are collected from sites throughout the watershed. These sites are selected to yield information on how the river changes as it flows from the headwaters to the mouth. This can help you understand the condition of the river ecosystem, identify problems and understand how these conditions are influenced by both natural and human-caused factors.
- An Impact Assessment Survey, which measures human impacts on the river, such as pollution discharges, dams and channel alterations. For example, visual information, field measurements, water samples and aquatic-life samples are collected at sites immediately above and below a discharge pipe.
- A Water Quality Standards Survey, which determines whether the river meets state and/or federal water quality standards. Rivers are classified according to government assessments of the uses and values which must be achieved. Water quality criteria lists the levels of various water quality indicators that must be attained to support these river uses and values associated with each classification. For example, Class B waters typically must support water contact recreation such as swimming. In New Hampshire, levels of E. Coli bacteria in 100 mL of a water sample should not exceed 406 to support swimming.

Which of these studies should you do? That depends on what you want to know about your river and your human and financial resources. The river characterization study involves collecting different types of information at many sites throughout the watershed. For example, you would want to collect as much information on as many physical, chemical and biological indicators as you can at sites that represent different river conditions: different stream orders, elevations, land uses and vegetative types. The impact assessment study involves collecting more focused information (depending on the impact being assessed) from sites above and below the source. This may require more sophisticated equipment and methods to detect a change in the river. The water quality standards study involves collecting and analyzing information, and comparing it with the maximum or minimum numbers for various water quality indicators contained in the water quality standards.

WHAT DO YOU WANT TO KNOW?

To figure this out, you need to know the issues facing your stream and some basic resource information. What are the uses and values? What and where are the pollution sources? Where are the riffles? What land uses might affect the river and where do they occur? Where are the dams, channelized reaches, water withdrawals and other potential impacts? Once you gather this information, you're ready to pose the study question. The type of study you do depends on the question you ask.

WHAT GOES INTO A STUDY DESIGN

A study design document is your record of how your study was done. It should be clearly written and organized so someone unfamiliar with your project can understand it. It should describe your data quality goals, which will depend on how and who you expect to use the data. If your group is doing a river characterization study for its own information or to flag problem areas, highly accurate data may not be important. On the other hand, if you wish state agency personnel to use your data to determine whether a discharger is violating the terms of its permit, you will need rigorous quality control procedures. Most studies fall somewhere in between these two extremes. Decide how and who you want to use your data before you decide what, how and where to look for it.

WATER QUALITY INDICATORS

Your study design should describe the water quality indicators you plan to use and your rationale

for using them. Since a river is an extremely complex physical, chemical and biological system, you can't possibly study every facet. Use water quality indicators that tell the most about the river for the least amount of effort and expense. Some commonly used indicators include physical (temperature, depth, flow), chemical (dissolved oxygen, pH, alkalinity) and biological (macroinvertebrates, fish).

SAMPLING LOCATIONS

Your study design should explain your rationale for choosing your sample sites and locate them on a map with directions on how to find each site. The idea is that all samplers should have no trouble locating the sample site to assure that the same sites are sampled each time.

FIELD PROCEDURES

Your study design should describe, in general terms, what procedures will be used to collect the information. It should also reference a specific set of procedures that will be provided to your samplers. We typically produce a packet for the samplers which explains what we hope to accomplish with the study, an equipment checklist, step-by-step procedures for collecting the samples, doing field measurements or recording observations, field sheets and directions on how to find the sampling stations. Attach this packet to your study design.

LAB PROCEDURES

Your study design should describe and reference the methods and procedures that will be used to analyze water or aquatic life samples. We usually produce a laboratory manual in a three-ring binder which contains an equipment checklist, the methods to be followed and the lab sheets for recording analysis results. In some cases, we follow a procedure spelled out in an existing source, such as *Standard Methods.* In other cases, we produce a paper which contains the step-by-step instructions, such as our *Guide to Benthic Macroinvertebrate Sampling.* In either case, laboratory personnel and volunteers need a single-source document that contains the procedures to be followed.

DATA MANAGEMENT AND ANALYSIS

You need a system for recording information as it is collected. Once you compile the data, you can organize and analyze it. Your data analysis forms the basis of the recommendations you make to the appropriate parties. Good data management and analysis makes it easier to present your findings to the audiences you wish to reach.

FIELD AND LAB SHEETS

Since data gathering starts in the field, you need field sheets to record information for each site on each date that sampling occurs. Field sheets should provide the date and time of collection, who collected the data, the site number and location, which bottle number was used to collect a particular water sample, and any notes or observations made by the samplers. They are also used to record measurements made on the spot, such as bank vegetation, stream velocity, water temperature and pH. For benthic macroinvertebrate sample sites, field sheets are used to record in detail the physical characteristics of the site and stream, such as stream bottom composition, amount of canopy cover and other factors that influence macroinvertebrate communities.

SPREADSHEETS, DATABASES AND MAPPING SOFTWARE

Once the data is recorded, you need to assemble it. Computer software for doing this falls into two basic categories: spreadsheets and databases. We use both at River Watch Network. For most applications a spreadsheet is adequate. Database software is more difficult to master, and charting features are often unavailable or rudimentary compared to spreadsheet software. Database software may be preferable, however, if your database is very large.

One of the best ways to display your data is on a map of the river and its tributaries. This shows the relationship between land uses and water quality, and other river data very clearly.

QUALITY ASSURANCE AND CONTROL

The degree of quality assurance and quality control (QA/QC) you need in your program depends

on how you will use the data. If you want to use it in court, you will need extensive control and documentation. If you are using it to diagnose potential problems with follow-up sampling by more precise methods, your QA/QC techniques and documentation need not be as advanced. In either case, strive for the most accurate and precise data possible and know how far off your results are from the best accuracy and precision possible.

SAMPLE COLLECTION

What are some of the techniques for QA/QC? First, be sure that your sample containers are the proper size and material and that they are properly prepared. For example, testing for phosphorus with the ascorbic acid method requires at least 100 milliliters in a polyethylene or glass container that is washed with phosphate-free soap, rinsed with acid and then with deionized water. You also need to know how long you can hold the sample before it must be analyzed.

If you are going to use your data in court, you'll need to record the chain of custody of the sample bottles. This requires a log sheet that registers the possession of the samples from the time they are collected to the time they are analyzed in the laboratory.

CALIBRATION OF INSTRUMENTS

Every time you take a sample you need to verify that your instruments are working properly and measuring accurately. They should be calibrated according to the manufacturer's directions and tested with known standards. All calibrations should be recorded on lab sheets.

BLANKS, SPIKES, DILUTIONS, SPLIT SAMPLING, DUPLICATES AND ARCHIVES

There are many ways of assuring that you are properly carrying out analytical procedures. You should regularly test a sample with a blank or a zero value. This will tell you that your equipment and technique are not biasing the results in a positive direction.

Spiking means that you test a sample first, let's say for phosphate, and then add a known concentration of phosphorus to the sample and test again. The result should be the first value plus the spiked amount. Dilution is the same idea except you are reducing the value by adding a volume of deionized water.

Split sampling means that you are giving half of some of your samples to another laboratory to test for the same parameters as you are. Duplicate sampling is where two samples are collected at the same time and place, and tested at two different labs.

Archiving refers to benthic macroinvertebrate samples. You save representatives of each of the identifications you have made in labelled vials filled with ethanol, which are later confirmed by an expert.

ORGANIZING A NATIONAL VOLUNTEER MONITORING SOCIETY

Jerry Schoen

Massachusetts Water Watch Partnership

FORMING A NATIONAL ASSOCIATION

One of the recommendations of participants of the Second National Workshop on Citizen Volunteers in Environmental Monitoring (Living Resources discussion group) was to form a national association of citizen environmental monitoring groups. This recommendation was reiterated by John Kopec of the Ohio Scenic River Stream Quality Monitoring Program in the fall 1990 issue of *The Volunteer Monitor* and by the editorial board of the *Monitor* in the fall 1991 issue. Consequently, a discussion session was held at the third national conference to explore and possibly adopt this idea. Approximately 45 people attended this evening meeting. Participants were asked to offer reasons for and against such a move. The following ideas were advanced.

REASONS FOR CREATING A NATIONAL ASSOCIATION:

1. It would help keep the existing network alive.
2. It would be a strong voice with which to deal with agencies who are currently reluctant to use volunteer-collected data.
3. It provides an effective national lobby for citizen monitoring.
4. It might help in obtaining funding, particularly from agencies, foundations and corporations that are national in scope.
5. It would raise awareness of volunteer monitoring.
6. It would be a source of assistance for small groups, in particular.
7. It would facilitate communication between groups.
8. It would help establish standardization of procedures, where appropriate.
9. It would provide organizational structure in regions that are experiencing difficulty forming regional associations.

REASONS AGAINST FORMING A NATIONAL ASSOCIATION:

1. It might create a self-serving bureaucracy.
2. It may be a time and resource drain to people who are already hard-pressed to care for their own programs.
3. Formalization tends to suppress spontaneity and grass-roots effectiveness.
4. Any standards imposed would come from the top-down, possibly destroying the benefits of locally oriented monitoring programs.
5. National standards aren't always desirable, due to ecological, political or other variations between regions.

After some discussion of pros and cons, a motion was passed, without dissent, to move forward with the formation of a national association.

SEVERAL PRELIMINARY GOALS WERE ESTABLISHED FOR THE ORGANIZATION:

1. To foster communication among groups.
2. To ensure the continued health of *The Volunteer Monitor* newsletter.
3. To provide an advisory board of experts available to answer questions on various topics.
4. To support research into various aspects of volunteer monitoring. In particular, to ex-

plore what degree of standardization of protocols is desirable and to encourage uniformity to that level.

5. To provide technical assistance to monitoring groups.
6. To provide training programs.
7. To encourage and assist the development of new programs.
8. To reach out to minorities and other elements of society which are not well represented in the volunteer monitoring movement.
9. To diversify financial support and reduce reliance on EPA.
10. To broaden the scope of environmental monitoring to include other types of monitoring.
11. To lobby for support of citizen monitoring. It was agreed that further discussion was necessary to determine the precise nature and scope of lobbying which would be most appropriate.
12. To provide advice on liability and other legal matters to monitoring groups.

It was agreed that these goals need to be analyzed in greater detail, amended as necessary and prioritized before significant further action would be taken by organizers of the association.

Attention then turned to deciding how to proceed from this point. Four initial needs were identified, and a steering committee was formed to address these needs. The steering committee reconvened on the following day and divided into four working committees to begin work on specific tasks:

1. A goals committee will further define and clarify the goals of the association.
2. A survey committee will develop a questionnaire to be widely distributed to volunteer program participants, asking for input on the desired makeup, purpose and activities of the association.
3. A communications committee will contact other national associations to discuss coordination of efforts.
4. A proposal committee will seek funds to conduct a feasibility study and develop a strategic plan for establishing the association. Assuming all goes well, further funding will be sought to get the organization up and running.

Inquiries about the association may be addressed to Jerry Schoen at the Massachusetts Water Watch Partnership, Blaisdell House, University of Massaschusetts, Amherst, Mass. 01003; 413/545-5532. Comments may be addressed to Schoen or to *The Volunteer Monitor*, 1318 Masonic Avenue, San Francisco, Calif. 94117.

Day 3:

OPENING REMARKS

Roberta Savage

President of America's Clean Water Foundation

America's Clean Water Foundation (ACWF) was established in January 1989 as a nonprofit, public service organization dedicated to protecting and enhancing the quality of our nation's waterways. Through a national campaign commemorating the 20th Anniversary of the Clean Water Act by focusing on The Year of Clean Water, the Foundation intends to rekindle public interest and promote personal stewardship of our precious water resources.

The Foundation's program has five main objectives: citizen involvement, youth education, professional exchange of technology, documentation of water quality status and trends since 1972, and public participation in the Clean Water Act's 20th Anniversary Commemorative Celebration.

The Foundation is unique in its reliance on a broad coalition of experts from all levels of government, public interest groups, private citizens, professional organizations and industry to accomplish its objectives. America's Clean Water Foundation's Steering Committee has an estimated public outreach of more than five million people.

The response to ACWF's programs has been overwhelmingly positive. With President Bush, Congress, individual states, cities, counties, associations, corporations and national groups adopting and proclaiming 1992 as their Year of Clean Water, the scope and credibility of these programs are further enhanced.

America's Clean Water Foundation's outreach extends throughout the globe. For example, the Foundation recently sponsored the World Water Summit in Atlanta, Georgia. This important event, hosted by former president Jimmy Carter and Board of Governors' Co-chairmen Senator Edmund Muskie and Senator Howard Baker, expanded the opportunity to affect the debate on clean water between international governments and world leaders.

The Foundation focuses on environmental change through citizen education and public involvement initiatives. To promote the protection of our water resources through student education and personal stewardship, ACWF has sponsored several pilot school programs including: computer assisted program for the learning disabled, environmental curricula for minority and rural schools, and educational videos. The Foundation has produced these tools through various partnerships and coalitions. Many of these educational products target our nation's youth as future leaders and initiators of environmental change.

In addition, hands-on citizen involvement activities sponsored by ACWF, including in-stream water quality monitoring, the Earth Day Clean Water Run and Exposition, stream cleanups and the National Envirothon have increased environmental awareness and encouraged positive community action. One of the most exciting educational activities is our environmental mystery musical that premiered on March 17 of this year. The play centers around a watershed and involves the members of the watershed; there is a salmon, a beaver, a duck and many others. They begin to notice a decline in the quality of their stream and hire a detective to find the cause. The play, entitled *The Murky Water Caper: A Real Fish Story*, is designed for older children (middle or high school students) to perform for elementary children. To date, the reception has been outstanding. If you would like to receive more information

on the play or any of our other activities, contact ACWF, 750 First Street, NE, #910, Washington, DC 20002; 202-898-0902.

It is the goal of the Foundation to involve every American citizen in the process of achieving and maintaining clean, pure water. The Year of Clean Water provides our nation with an excellent opportunity for Americans of all ages to become personally involved in the business of keeping our water clean. We appreciate the support of our Board of Governors, Steering Committee, Celebrity Advisory Council and the members of America's Clean Water Foundation, and we look forward, with your continued help and support, to achieving our goals for The Year of Clean Water.

Workshop Sessions IV: Outreach and Action

NONPOINT SOURCE POLLUTION MONITORING

Presenters: Donna Sefton, United States Environmental Protection Agency, Region Seven; and John Kopec, Ohio Department of Natural Resources.

Donna Sefton

United States Environmental Protection Agency

VOLUNTEERS AND NONPOINT SOURCE MONITORING

Nonpoint source pollution (NPS) comes from diffuse sources, rather than distinct pipes or point sources discharging effluent from sewage treatment plants or industries. NPS pollution results from our activities on the land and is caused when rainfall or melting snow moves over and through the ground, picks up pollutants along the way and eventually reaches a waterbody. NPS pollution may also result from atmospheric deposition.

Nonpoint source pollution is responsible for the vast majority of impaired or threatened lake acres, stream miles and coastal waters in the United States. The leading NPS pollutants are siltation, nutrients, pathogens and pesticides. The leading sources of NPS pollution are agriculture, urban runoff, forestry, livestock grazing, mining, hydromodification and atmospheric deposition.

Best management practices are implemented in a watershed to control nonpoint source pollution. The Coastal Zone Reauthorization Act Amendments require EPA to develop guidance on management measures that can be used in NPS prevention or control.

SECTION 319 NPS MANAGEMENT PROGRAM

Section 319 of the 1987 Amendments to the Clean Water Act established the Nonpoint Source Management Program. The program required states to prepare a Nonpoint Source Assessment Report which determined the effects of nonpoint source pollution on waters of the state, and then develop a a program for implementing methods to control NPS pollution to priority waterbodies in the state. At least in EPA Region Seven, the nonpoint source assessment is updated every two years with the biennial state water quality report required by Section 305(b) of the Clean Water Act.

Since 1990, EPA has provided funding to states (with approved NPS assessment reports and management pograms) for implementing information, education, technical assistance and regulatory programs as well as watershed demonstration projects consistent with their management programs. National guidance requires that each watershed project include monitoring and information/education/technology transfer activities.

ROLE OF CITIZEN VOLUNTEERS

Some of the ways citizen volunteers help collect data related to nonpoint source pollution include:

1. Inventoring waterbody, habitat and watershed conditions, and screening for problems;
2. Collecting baseline data where little or no prior data exist, documenting the impacts of nonpoint source pollution on water resources, justifying the need for a watershed management project and promoting action;
3. Providing credible pre- and post-implementation monitoring data; and
4. Collecting long-term monitoring data to examine trends in water quality.

INVENTORING/SCREENING

For example, the Missouri Stream Team Program uses volunteers to inventory waterbody, habitat and watershed conditions. The Stream Team Inventory is a two-stage process that documents stream conditions and screens for problems. A stream team inventory manual provides background information and guidance for assessing the condition of the stream. The second stage is the inventory form. It provides a short description and pictures of what healthy or abused streams look like. Seven different components are used to assess stream quality: watershed, riparian zone, stream bank, stream channels, fish and wildlife habitat, scenic beauty and water quality.

The Stream Team Inventory Form also has a problem identification checklist to rate the degree to which certain problems apply to the stream being inventoried. These include: riparian zone condition, livestock access, proximity of feedlots to water resource, streambank condition, turbidity of water, presence of debris and garbage, and pollution sources, including storm sewers, field tiles and construction erosion.

COLLECTING BASELINE DATA

Citizen monitoring data may be the only baseline data available for a waterbody. Each state has hundreds of lake waterbodies and thousands of miles of streams. Because of limited monitoring resources, only about a third of United States river miles and half of lake acres have been assessed by the states. Trained citizen volunteers using quality-control methods add to our baseline of water quality information and screen for problems in otherwise unmonitored waters.

For example, in Illinois' biennial State Water Quality Report required by Section 305(b) of the Clean Water Act, more than half of the 400 lake waterbody assessments are based on data obtained from citizens under the Volunteer Lake Monitoring Program.

In North Carolina, even though the state maintains an extensive ambient stream water-quality monitoring network which includes about 200 sites sampled either quarterly or monthly, only three sites are located in Buncomba County, near Asheville. The county Volunteer Water Information Network increased this level of information to 45 sites sampled monthly, or about a 45-fold increase in the amount of county-level stream data.

One of the major goals of the Rivers of Colorado Water Watch Network is to obtain accurate and consistent baseline water-quality data on the rivers of Colorado.

DOCUMENTING NPS IMPACTS TO PROMOTE ACTION

Data collected under the Illinois Volunteer Lake Monitoring Program is used to document the effects of NPS pollution on lake quality and justify the need for watershed management projects. In addition to Secchi disk transparency readings, water color, sediment, algae, aquatic weeds and meteorologic conditions are observed. For example, at Dunlap Lake, Illinois, reduced transparency was associated with rainfall. The influence of the watershed on lake quality and the need for a watershed project was documented through the volunteer monitoring program. This was also true for Briarwood Central Lake, an urban lake in the Chicago area, where data collected by citizens promoted local action to correct identified problems. The data was then used to evaluate success of the measures implemented.

At Shipshewana Lake, Indiana, volunteers were used as a cost-effective approach to collecting high resolution site-specific tributary and lake water column data for model calibration and verification. Lay volunteers were trained in the operation of basic limnological instrumentation, sample collection, data recording and sample shipping. Monitoring consisted of bi-monthly water quality sampling at 11 stations in the lake and tributaries, and storm event samples collected at 11 stations throughout the watershed.

COLLECTING DATA

Student volunteers are collecting pre- and post-implementation data for the Section 319 funded Wolf Creek riparian restoration project in Plumas County, California. Over a 10-year period, the students will regularly monitor revegetation success, habitat, aquatic invertebrate/fish populations and physiochemical data.

Apple Canyon Lake in Illinois provides another example of pre- and post-implementation data to show project success. From 1982 to 1985, before implemen-

tation of watershed best management practices, the average transparency was 60 inches; from 1987 to 1989, after implementation, the average transparency was 110 inches.

The previous data from Apple Canyon Lake and Briarwood Central Lakes collected under Illinois' volunteer program shows how citizen data can be used to determine long-term trends in water quality. The Illinois program has 11 years of data on 150 lakes. Vermont, Minnesota and New Hampshire lake monitoring programs each have over 12 years of data.

NATIONAL NPS MONITORING GUIDANCE

EPA has prepared guidance for use in national NPS monitoring projects. Although this type of detail is not required for all NPS projects, the basic concepts in the guidance may be useful in designing your NPS scheme.

The national NPS monitoring objectives are to detect changes in water quality, biology and/or habitat over time and to relate the changes to activities in the watershed. The changes may be in such parameters as mean pollutant concentration or biological/habitat measures, which can be monitored by volunteers. Three major approaches are recommended in monitoring design. The most preferable approach is to monitor paired watersheds (two similar watersheds in close proximity; one with and one without implementation). A modification of this is to use a eco-region approach and compare the site to reference sites for that eco-region. Another approach is to have an upstream, background site in which the best management practices (BMPs) to be evaluated are not being implemented in the watershed, and a downstream site which drains the area in which watershed BMPs are being implemented. The third approach is to have a single downstream site monitored before and after implementation. There should be at least three years of pre-implementation data and three years of post-implementation data.

The suggested monitoring frequency is weekly grabs for chemical parameters, one to three times per season for fish, once per season for macroinvertebrates, and one to two times per season for habitat. To obtain information best suited to document statistical differences in pre- and post-implementation data, the golden rules are consistency and constancy.

Monitoring parameters are the pollutants addressed by the NPS implementation project (nutrients, suspended solids, oxygen, temperature) as well as covariates (explanatory variables, such as precipitation and streamflow). Monitoring parameters may be chemical, habitat or biological.

Chemical monitoring may involve such parameters as Secchi disk transparency, pH, temperature and dissolved oxygen, which may be analyzed in the field by volunteers. Other parameters, which may be collected by volunteers, but should be analyzed by an EPA-certified lab using EPA-approved procedures include turbidity, total suspended solids, nutrients, metals and pesticides.

Habitat monitoring may include riparian/bank condition, substrate, channel morphology, cover/habitat and streamflow. Biological monitoring may include macroinvertebrates, fish, aquatic vegetation, plankton/periphyton and egg survival.

VALUE OF CITIZEN MONITORING IN NPS PROGRAMS

The value of citizen monitoring in dealing with NPS pollution transcends water-quality data collection. Since NPS pollution results from people's activities on the land, the solution to the problem also lies in education to promote awareness and local action to solve problems. The way to control NPS pollution nationwide is for all citizens to do their part. The real power of citizen involvement in NPS monitoring is to get citizens to take action to make a difference.

John Kopec

Ohio Department of Natural Resources

VOLUNTEER MONITORING IMPACTS ON NONPOINT SOURCE POLLUTION

The Section 319 provision of the 1987 Clean Water Act Amendments set national and state strategies for addressing nonpoint source pollution and

provided an excellent opportunity for using citizen volunteer water monitoring programs.

Throughout the nation, there are countless streams, lakes and other water resources for which little or no physical, chemical or biological data exists. As the legions of citizen volunteers grow through the addition of new programs and expansion of existing ones, valuable information will be generated for many of these neglected waters. This is important, since most water resources suffer from some aspect of nonpoint source pollution, and historical water-quality data is critical for the success of a nonpoint program.

One very important component of a nonpoint plan is public education. Many best management practices dealing with agricultural issues, for example, are voluntary in nature and depend upon a sound program of information and education to be implemented. In most cases, financial incentives and regulatory measures are either wholly lacking or often inadequate. Acceptance by the non-regulated community of measures that need to be taken to reduce nonpoint source pollution must be based upon a comprehensive understanding of basic biological and chemical principles that underlie watershed ecology. For instance, before they make a commitment to help establish, protect or restore their riparian forests, streamside property owners often need to discover how these buffer zones play an integral role in maintaining water temperatures and providing a food source for aquatic organisms.

Working with local agricultural agencies, such as the Soil Conservation Service, Soil and Water Conservation Districts and Cooperative Extension, the Ohio Department of Natural Resources helped conduct several streamside and watershed workshops during 1991. Local farmers, government officials and citizens were invited to learn about the fish and other aquatic organisms that lived in the streams. It was evident from talking to those in attendance that the relationship between land-use practices and the overall health of the aquatic resource was more readily understood. Several participants also expressed an interest in joining Ohio's ongoing programs of stream and lake monitoring.

The Storm and Surface Water Utility of Bellevue, Washington, has incorporated citizen involvement through a stream team concept which gives residents the opportunity to gauge for themselves the health of their local waterways. Using receiving waters as a focal point for nonpoint pollution education, Bellevue has been successful in cultivating an active and informed constituency of citizens who participate in protecting and enhancing their city's water resources.

For citizen monitoring programs to be effective educational tools to combat nonpoint source pollution, they must involve a cross-section of society. There is hardly an individual, young or old, whose daily actions do not have some influence on the quality of his or her environment. Nonpoint sources that include household sinks, toilets, backyard gardens, driveways, downtown sewers, construction sites and agricultural fields constitute a problem to which everyone contributes and for which everyone is responsible. To address this, citizen monitoring programs should target not only schools and youth groups, but garden clubs, civic organizations, sports groups, individual families and any other willing participants.

Citizen monitoring programs should be expanded, if possible, to include biological along with chemical monitoring regimens, with an emphasis on establishing monitoring stations throughout the watershed, from headwater streams to impoundments. Rather than pinpointing areas of concern, such as establishing stations above and below a suspect municipal outfall or industrial discharge, the total watershed comes into focus as the area of concern. By deploying citizen volunteer monitors to a wide variety of stations throughout the watershed, program participants gain a better understanding of the enormity of the problem and the cumulative nature of nonpoint source pollution. This approach also helps determine the best management practices to solve the problem.

WATERSHED WALKING

Presenters: Meg Kerr, University of Rhode Island; Joseph Bachant, Missouri Department of Natural Resources; and Amanda Lindley Stone, Audubon Society of New Hampshire.

Meg Kerr

University of Rhode Island

RIVER RESCUE PROGRAMS

Volunteer monitoring programs around the country promote watershed walking and mapping techniques. Watershed walking is inexpensive, can be used on any type of watershed and appeals to a wide range of volunteers. It can provide a wealth of useful information on the current condition of the aquatic ecosystem and can identify potential threats to the system's water quality.

This workshop will cover the basic aspects of a watershed mapping project. I will end my section by describing the Rhode Island River Rescue mapping and pipe detective programs. River Rescue volunteers work on four urban rivers that flow into the upper end of Narragansett Bay. The rivers and their watersheds have been used for industrial purposes for more than 100 years. The rivers have been dammed, re-routed, dredged and even paved over, and retain few of their original features. Mapping techniques have been developed that are specific to these highly urbanized rivers.

REVIEW OF VISUAL ASSESSMENTS

Visual assessments can be performed on any type of waterbody. Waterways of all kinds are affected by point and nonpoint sources of pollution, and visual surveys are useful as a first step in identifying these sources. Visual surveys provide information that allows program managers to identify the current condition and value of an aquatic resource and can be used to set objectives for improving the resource. Repeated surveys can also be used to track changes in a watershed over time.

The following steps are usually recommended for volunteers interested in doing a watershed survey:

1. Select an area to survey. The size of the area selected will vary depending on the type of waterbody examined and the goals of the survey. Some volunteers are interested in watching changes in a section of shoreline or beach. They should select a small section so they can measure the beach profile and document in great detail the site characteristics. Other volunteers may be interested in understanding the potential sources of pollution to a lake or river. They would choose a larger area to survey and would collect less detailed information.
2. Review maps of the segment selected for the survey. U.S. Geological Survey (USGS) topographical maps, available at most hiking and camping stores, are useful for identifying watershed boundaries. Highway maps provide information on access to the waterbody. Local planning agencies will have plot maps useful for identifying landowners within a watershed. The maps often have other detailed features of the waterbody that can be useful on the watershed survey. Local sewer commissions will have maps showing their collection system. Reviewing these maps will show mappers development areas that are not served by the sewers. This is important since failing septic tanks can be a serious

source of nonpoint source pollution to many waterbodies.

3. Draw a map (or maps) of the area you plan to survey. On the map, draw in permanent features such as road crossings and tributary streams. Set the scale of your map to reflect the purposes of the survey and the amount of information that will be displayed. If you are mapping the land use of the area, urban sections will probably need to be shown in more detail than rural areas. It is useful to cross reference your maps to a USGS topographical map or other standard map of the watershed. This will help data users, such as local water quality planners, understand where you have collected your data.
4. Make several copies of your maps to take with you into the field. Have a rough field copy that you clean up when you get home; don't mark on your original maps when you are in the field.
5. It is often best to do a reconnaissance survey before you go out for your final mapping effort. During the reconnaissance, drive around the area. Make note of areas where you can access the river. If you are planning to walk along the river, ask permission from landowners adjacent to the river. If you will be doing some of your survey by boat, figure out put-in and take-out points.
6. Before heading out in the field on the day of the survey, sit down and write a few notes. Include: the weather on the day of the survey; weather conditions for the two days prior to the survey; the date and time of the survey; the names of people participating in the survey; and a short summary of how you plan to perform the day's survey (this will be your plan of action for the day).
7. Bring in the field with you: boots, snag and thorn-proof clothing; clipboard with waterproof cover; maps, pencils and ruler; camera and film; gloves; and a buddy. Always work with someone.
8. Drive, walk or boat around your segment. Make detailed notations of the characteristics of the waterbody.

The specific characteristics of interest vary from program to program. For example, EPA Region 10 has developed a streamwalk program designed specifically for streams and small rivers. Volunteers are asked to provide information on the physical characteristics of the stream, measuring the width and depth of the stream, the width of the stream corridor, and the stream gradient. They make notations of the type of streamside vegetation and stream cover, the condition of the stream bank, and the percentage of the stream surface area covered by pools and riffles. They look for specific problems in the stream such as bank erosion or modification, sand and silt in the stream, stream bed purturbations, algae and aquatic weeds in the water and junk in the stream. An effort is made to identify the likely cause of the problems.

In contrast to the EPA method, Seattle's Adopt-A-Beach program has developed a baseline monitoring project for beach sites that includes a site evaluation where volunteers make detailed notes, observing animals and plants at the site, the color of the water and the general condition of the site. Additional projects encourage volunteers to measure and plot the profile of the beach and make detailed characterizations of beach transects.

RIVER RESCUE VOLUNTEERS MAP URBAN RIVERS

Rhode Island's River Rescue program is particularly interested in gathering information on urban rivers. Volunteer river mappers are asked to measure and observe pipes leading to the rivers and culverts discharging to the rivers. They note the types of buildings along the rivers, whether the area is industrial or residential, and the density of the development. Volunteers describe the location of large debris, such as cars, refrigerators and shopping carts. They observe the color, smell and general appearance of the water, looking in particular for the presence of oil on the water.

River Rescue mappers also try to do some detective work on the numerous pipes that lead to the rivers. Some sections of river have pipes leading to the river every 10 feet, and no one knows the exact status of discharges from these pipes. Some pipes are

existing waste discharges permitted under the state National Pollutant Discharge Elimination System, and some are abandoned outfalls, left over from industries that are no longer at the site. Some pipes are combined sewer overflows, while others are existing or abandoned storm drains.

Volunteers are asked to inventory the pipes along a section of river. They measure the pipes and note the color of any water discharged from or sitting in the pipe. They observe the condition of the river bank below the pipe to see whether it is eroded. They are asked to re-visit the river section during different times of the day and on different days of the week. They visit the pipes during dry and wet weather. On each visit, they notice whether the pipes are flowing. If they are flowing, they document the characteristic of the discharge, including its color, odor and apparent temperature. (Is it steaming?) They also re-examine the bank below the discharge, looking for new signs of erosion.

Pipe inventory information is used to assess sources of pollution to the rivers. The Rhode Island Department of Environmental Management will use the information in their ongoing nonpoint source evaluations and assessments. Any continuous discharges found by the River Rescue volunteers will be investigated and removed or permitted.

Joseph P. Bachant

Missouri Department of Conservation

A VIEW FROM THE WATERSHED — MISSOURI'S RIVER PROGRAM

Missouri has more than 56,000 miles of streams. The quality of these resources has steadily declined over the past century due to land clearing, channelization, pollution, impoundments, diversions and other abuses. Over 5,000 miles of streams have been channelized and an additional 2,920 miles are affected by the flood pools of mainstream reservoirs.

Missouri's citizens first became alarmed at the declining condition of their river resources in the late 1960s and early 1970s when it seemed that every remaining free-flowing stream had at least one proposed major dam project. The 1970s and early 1980s were a period when all efforts were focused on stopping or altering massive federal water projects. While these efforts were largely successful, a tunnel-visioned mentality resulted from focusing on the immediate sites involved in the projects under question. This mindset prevented many people from seeing rivers as large complex systems.

During the last decade, however, natural resource scientists and managers began to see the need to examine all the river basin parts to better understand the whole. Required impact analyses of a wide range of activities demanded a keener insight to cause and effect relationships on a watershed level. This new science is rapidly evolving on many fronts and provides the professional with the challenge of keeping up with literature in several disciplines. Unfortunately, many concerned citizens have not had the opportunity to gain these new insights.

In 1986, the Missouri Department of Conservation created a new comprehensive river conservation program called Streams for the Future. Basic aspects of this program include training department and allied agency personnel in the scientific/technical functions of riverine ecosystems, including their watersheds. The department's approach to river problems is holistic in nature and geared to applying solutions from the top of the watershed down. For example, Missouri has sustained massive losses of top soil. Restoration of viable river systems is not feasible until the uplands within affected watersheds have corrective land-use practices installed.

Another fundamental cornerstone of the program is to raise public awareness of river/watershed problems, especially those affecting areas of public concern, such as recreation, water quality, fish and wildlife. An important subset of the public awareness effort is to create a new constituency for river conservation with a broader vision than the mentality of a decade or more ago. One approach to seeking, informing and involving this new constitu-

ency is through our Missouri Stream Team program. Our goal is to find potential leaders, and educate and empower them to become better resource advocates.

One of the first tools created for educating our leaders is a subjective environmental assessment called the Stream Team Inventory. This simple survey instrument examines seven basic parameters of stream health: watershed, riparian corridors, streambanks, stream channel, fish and wildlife, scenic features and water quality. Introductory training is available, but the assessment was designed to be self-explanatory and get people to begin thinking holistically.

Advanced inventory training planned for the near future will dwell in detail on each of these seven parameters. The goal, however, will always be to examine each parameter within the context of its influence or interaction on each of the other parameters.

Based on our experience, initial training for a watershed assessment will be very basic. Most persons are familiar with their address on a political boundary basis (city, state), fewer on a ecological basis (great plains, prairie); hardly any person can geographically place themselves on a watershed basis. In addition to map reading and similar basic skills, most people will have to learn to read the landscape. For example, major land-use activities such as clear cutting or subdivision construction may draw attention, but the cumulative effect of sheet soil erosion within a watershed can be even more damaging and easily overlooked. Crash courses in soils, vegetation and landforms such as karst will also be needed. Once these skills are mastered, sampling strategies can be devised to help observers rate watershed conditions. Then and only then do we believe that valid watershed condition judgements can be generated by the concerned public.

The department's goal is to cultivate a true partnership with these new constituents. In addition to generating a common ground of concern for our state's flowing water resources, this partnership must also prosper on a common wealth of knowledge. Training and education are the clues. Professional knowledge must be effectively transferred to the private sector if a new era of informed resource concern and advocacy is to arise.

As an ex-governor from the state of Oregon recently said in a meeting similar to this, "Political action is the product of public opinion, and public opinion is the product of informed individual action."

Learning to understand broader landscapes such as watersheds yields a holistic view to the nature of river and water-quality problems. This insight then suggests stewardship and advocacy opportunities open to each individual. When this is achieved, perhaps the day of positive political action on major land-use issues will be at hand.

Amanda Lindley Stone

Audubon Society of New Hampshire

WATERSHED DELINEATION AND MAPPING

Before starting a watershed walking program, it is essential that the fundamentals of watershed boundary delineation and mapping are understood. In addition, an understanding of how watersheds function and are impacted by different land uses is critical for more efficient management of the quality and quantity of our water supplies.

Defined simply, a watershed is the geographic area that is drained by a single river and its tributaries. It includes all the land that surrounds a watercourse and contributes water to it — that is, all the precipitation in that area drains towards a single watercourse. The river system in any one watershed could be as large as a major river or as small as a local brook. (While it is recognized that there are both surface and groundwater watersheds, this paper focuses on surface-water watersheds).

The watershed functions as an integral part of the hydrological system and must be considered in this context. To understand how watersheds function, it is important to have a basic understanding of the

hydrological cycle (the continuous and indefinite cycle of water between the sea, air and land), an ability to interpret topographic maps, and an understanding of the impacts of different land uses on the quality and quantity of the river flow draining the watershed.

A drainage network is a system of stream channels linked together like the branches of a tree. Each watershed on the landscape is characterized by a drainage network. Development of the landscape frequently alters natural drainage networks by changing the land surface, such as creating artificial channels, building dams or creating urban areas. Such alterations can have serious environmental consequences, including increased flooding, decreased water quality and reduced water supplies during times of low flow. To prepare better management and planning strategies, valuable information can be derived by documenting the different land uses within a particular watershed and the potential for impacts on water quality and quantity.

When new development is planned, knowledge of existing land use, steep slopes, runoff collection areas, unstable and poorly drained soils, areas prone to flooding and seepage, water supply areas and important wetlands can help determine the limitations for development. This knowledge can also help planners make decisions regarding which parts of a watershed are best suited for development with minimum impact to the natural resource base.

Clearing and developing land often has a pronounced influence on drainage networks and watersheds. This affects both water quality and water quantity. Agricultural activities can impact drainage basins and stream networks through the creation of drainage ditches and tile drains. In addition, excess nutrients (nitrogen and phosphorous, the components of fertilizers) from waters running off agricultural lands can cause rapid plant and algal growth, and oxygen deficiencies in rivers, lakes and reservoirs. Urbanization also leads to considerable changes in drainage networks. Natural channels may be replaced by ditches or underground channels (in the form of storm drains and sanitary sewers). Paving over large areas with asphalt and concrete greatly increases the rate at which storm waters run off the land, thus increasing the likelihood of flooding. Urban areas are also the source of a number of pollutants which adversely affect water quality.

Perhaps one of the most important effects that humans have had on water quality is the contribution to levels of suspended sediments in streams as a result of erosion. For example, deforestation, agricultural practices (such as plowing and grazing), road and building construction, and the introduction of spoil materials into rivers by the mining industry have all led to substantial increases in stream turbidity. Pollutants that are bound to sediment particles are consequently transported into the river system. These are a few of the activities that can impact on quality and quantity of water in watersheds.

Watershed delineation is a procedure where the boundary of the watershed is drawn on a topographic map, such as a USGS topographic quadrangle. At each point along a watercourse, the land slopes up on each side to some high point and then down into another watershed. High points are generally hill tops, ridge lines or saddles. If all these high points around the watercourse were to be joined, this line would form the watershed boundary. This boundary serves as the basis for a watershed map.

Any point on a watercourse can be used to define a watershed. For example, the entire drainage area of a major river can be considered a watershed, but the drainage areas of each of its tributaries are also watersheds. Each tributary in turn has tributaries, and each of these tributaries has a watershed. This process of subdivision can continue until very small watersheds are defined which might only drain a few acres.

When delineating the boundary of a watershed, there are several fundamental questions that need to be answered: What happens to a drop of rain when it falls on the ground? In which direction will it flow? Which route will it take? Which river system will it join?

A critical first step in delineating watershed boundaries is to visualize the landscape as represented by a

topographic map. This requires an ability to interpret the contours, and an understanding of how the contours on a topographic map relate to water flow. When determining the direction of water flow, the general rule is that the flow direction is downslope and perpendicular to the contours; and that the V-shaped contours indicating a drainage line always point upstream. With that in mind, it is not difficult to make out drainage patterns and the direction of flow on the landscape, even when there is no stream indicated on the map.

Before going out into the field to walk a watershed, it is essential to compile a map of the watershed using published sources of information. This both simplifies and enhances field mapping. To prepare a watershed map, the following resources are helpful:

1. A USGS topographic quadrangle for the area to be mapped: This is essential for delineating the watershed boundary and the drainage network.
2. Aerial photographs: Large-scale black and white aerial photographs provide baseline information on the different types of land use and where these land uses are located within the watershed. Any one watershed can be characterized by a number of different types of land use. For example, watershed A may be 80 percent forested, with the remaining 20 percent comprising rural residential areas; watershed B may be 35 percent forested, 50 percent agricultural, and 15 percent rural residential; while watershed C may be dominated by a high density urban environment with only 10 percent open land. Each of these watersheds will function differently.
3. Historical and local records: Many reports held by municipal, state and federal agencies can provide valuable data concerning a particular watershed area. Such information can include water quality reports, known sources of contamination in the watershed, public water supply information, dam construction and other studies that have been conducted in the local area.

Information documented on a watershed map should include at least the following:

- Steeply sloping areas (slopes greater than 25 percent);
- Drainage networks;
- Lakes, ponds and wetlands;
- Known water supply areas (surface or groundwater);
- Different types of land use (residential, commercial, industrial, forested, agricultural or open land);
- Areas of erosion or gullying;
- Major roads or highways;
- Floodplain areas;
- Any other relevant information.

Once a map of the watershed has been prepared from all available published sources of information, field mapping can begin. The initial watershed map may be modified, corrected or added to as more data is collected in the field. Field checking exercises require a good eye for detail and noting all factors that could be affecting the watershed. In addition, the mapped watershed boundary should be confirmed in the field.

Watershed maps can be used to assess the level of impact of land uses on water resources within the watershed (including wetlands, watercourses and lakes) to determine the areas where erosion is occurring and to prepare for better planning and management practices within the watershed.

Rivers, lakes and wetlands all form critical components of our water resources. At the same time, these areas are vulnerable to adverse impacts arising from construction, urban development, agriculture, mining and silvicultural practices. There is often a need to collate scattered sources of information and conduct a comprehensive inventory of watershed areas to foster a better understanding of the factors influencing watersheds and optimize the quality and quantity of our water supplies.

Current land-use planning practices seldom take into account watershed impacts. In particular, piecemeal development has significant cumulative effects. There is a clearly a need to adopt a watershed approach to land-use planning. Each point on the landscape is part of a watershed, and every time the landscape is impacted, a watershed is affected.

It is important to note that watershed mapping is the first step in the process. There needs to be follow-up with regard to monitoring, better planning and management strategies. Volunteer groups are ideally situated to take part in watershed mapping programs, to participate in restoration efforts and citizen clean-up programs, and to assist in monitoring those areas for future adverse impacts. However, before starting on such programs, it is essential that volunteer groups have been through an initial training program in the fundamentals of how watersheds function and the value of watersheds in landscape planning, as well as how different land uses can impact watersheds, how to read the landscape, interpret topographic maps and delineate watershed boundaries.

REFERENCES

Ammann, A.P. and A.J. Lindley Stone, 1991: Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire. Published by the New Hampshire Department of Environmental Services. NHDES-WRD-1991-3

Marsh, W.M., 1983: Landscape Planning - Environmental Applications. Addison-Wesley.

Shaw, E.M., 1983: Hydrology in Practice. Van Nostrand Reinhold (UK).

ENVIRONMENTAL EDUCATION AND COMMUNITY OUTREACH

Presenters: Marcia Moore Homsey, Adopt-A-Stream; and Tom Murdoch, Adopt-A-Stream Foundation.

Marcia Moore Homsey

Adopt-A-Stream

STARTING PROJECTS WITH SCHOOLS AND CIVIC ORGANIZATIONS

Working with school children has been one of the most rewarding aspects of the Adopt-A-Stream program I began in Cedar Rapids, Iowa.

Programs can be set up in cooperation with county conservation plans, County Soil and Water Conservation Districts, Four H clubs, or any other civic group. To begin, invest in a roll of slide film and go after those shots of pollution that you will easily find. Examples might be photos of litter in parking lots, urban erosion (very easily found), oil and grease floating on the water's surface and factory discharge pipes. Simply contact a school principal or teacher about presenting your slides to students about pollution, what to look for and how they can help.

I take a 40-minute program into the classroom, sitting right among the younger students rather than in front of them. I often sit on the floor with the kindergarten children as I show them, by example, how water pollution occurs. My discussion begins with an explanation of how very small and vulnerable the amount of water on earth is and how already there are foreign countries without safe water supplies and even water shortages in certain areas of our country. I give them a good perspective of this by referring to an analogy made by Jacques Cousteau: If the world were reduced to the size of an egg, a drop of water on the egg would represent the supply of water on earth available to humans and wildlife. It is precious, isn't it?

I take a clear fruit jar of water into the classroom and tell the students that before the settlers tamed the wilderness and the industrial revolution came about, the American Indians could drink directly from this country's waterways. The Indians were very kind to Mother Earth for they realized they were dependent upon the earth's bounties. I take a drink from the jar just as the Indians could drink from the natural waters. Then I begin to physically demonstrate how water pollution occurs using small, clear 35 mm film canisters filled with the following:

1. Soil: representing the uncontrolled urban erosion in our area;
2. Sand: representing silt from sand spread in the winter on streets and filth from commercial parking lots;
3. Used motor oil: representing oil drippings from autos and the tons dumped illegally down storm sewer drains;
4. Litter: found abundantly in our towns/cities;
5. Cigarette butts: found abundantly in parking lots/streets, undigestible to marine life and filled with nicotine which is very poisonous;
6. Anti-freeze: representing what is dripped from autos onto streets and parking lots, dumped illegally down storm sewer drains; it is very sweet-tasting to wildlife and very poisonous.

All of this pollution I remove from parking lots with the exception of used motor oil and yellow food-coloring to represent anti-freeze. As I add the contents of each of the film canisters into the jar of water from which I had previously drunk, I explain the damage each pollutant does to our precious

water resources. I explain the term storm sewer drain and how we need to change our philosophy when it comes to storm sewers: they need to be called waterway drains for that's exactly where these drains lead!

I am continually amazed by the people who either do not know that these storm drains lead directly to our waterways or have never thought of it before they heard me speak. Further, I explain that litter in their community washes into the Cedar River, then the Mississippi, and on into the Gulf and finally the ocean. This fact amazes children, but most importantly it concerns them. They quickly realize that they can really make a difference in the world by their actions in their backyard. They are told to look around their neighborhood for signs of pollution. I end my presentation by offering everyone a drink of the water I've just polluted — they refuse. I encourage them to be brave enough to tell someone they see littering not to trash Mother Earth.

I also explain how a municipal water pollution plant does not always remove all chemicals from household cleaners and that their family needs to read labels carefully before purchasing and using household cleaners, and use alternative products which are safe for the environment.

Even recycling the fruit and vegetable scraps into a compost pile rather than their garbage disposal takes a burden off the city water pollution plant and conserves water. During the winter these scraps can be placed in a covered receptacle outside and near the door, and be emptied into the compost pile when the first spring thaw comes along.

Students can learn a lot from a 40-minute class and readily understand that their future is at stake. After doing a class for Harding Middle School in northeast Cedar Rapids, I was pleased to see the actions the teacher and students took after learning the consequences of water degradation. Students began to test the water in a small stream that ran under their locker link. During the initial building plans the architect thought it delightful to build the locker link across this peaceful little stream which formerly was surrounded by farm fields.

This was a wonderful idea to begin with, but shortsighted; as commercial development encroached upon the stream, the stream was used by these commercial businesses to drain their hard surface runoff. But only a few years ago during a heavy spring rain, the peaceful little stream became rapidly overloaded and rose so high the velocity of the rushing water damaged the locker link. This was a learning situation for all students and for the janitor of the school who was unaware of why the stream came up so high. The students could see first hand why there is an urgent need for best management practices for on-site storm water management.

The Harding students removed litter from the stream, inventoried it and labeled each type as to how long, if at all, it would take to decompose and the hazard each poses to the environment. This display was put on tables in the hallway for all to view. It was a real eye opener. Students tested the stream water in their lab for nitrates, pH, phosphorous and types of algae found in non-polluted and polluted water. Students are now planning a trip to City Hall and a presentation to the City Council, which is a great learning experience for them.

Large, five-gallon buckets were donated from Swiss Valley Farms Dairy here in Cedar Rapids for volunteers to take into a waterway for collecting litter. We find these buckets are reusable and kept out of the landfill, an added bonus. I print Adopt-A-Stream on each bucket for advertising.

Presentations you do should include not only your knowledge and slides, but any problems pertaining to your area. My slides created such an awareness among Metro Senior High students that they adopted a section of Indian Creek, called the media and scheduled regular cleanups. They were praised by the community, which resulted in increased self-esteem and pride.

Field trips are the best way to teach the problems our waterways face. Students need to be taken to a stream to view it themselves. I make arrangements with the teacher to do a field trip after the initial presentation. This works wonderfully and the students enjoy it, especially when a teacher gets right in with them.

Another great factor is that students go home, talk to their peers, their family, parents, grandparents and neighbors. The word spreads quickly through the community. It's up to us to teach the youth of today; time is running out. I fear the environment is being put on the back burner because of the economy. More than ever, it will take a total grassroots movement to improve our water quality. Any major social changes in this country have come from a grassroots level and this major change too must come from citizens.

Basically a slide presentation and water pollution demonstration can be taken to any club or organization to show people the problems they don't normally view from their automobiles as they rush through their daily life.

I leave you the fact that WATER IS LIFE, let us all protect it.

Tom Murdoch

The Adopt-A-Stream Foundation

HOW TO LAUNCH PUBLIC AWARENESS CAMPAIGNS

There is no magic formula to launching a public awareness campaign. Of course there are some fundamental steps that are applicable to any campaign. First you must have a clear picture of the goals you want to achieve. You should also have measurable objectives enabling you to evaluate your progress, a date-specific plan of activities designed to reach those objectives and an adequate budget.

While your goals will be a driving force, your budget, in terms of human and financial resources, will set some boundaries. You can do a tremendous amount with little money provided you have volunteers with time and energy, and leadership is provided for follow through.

A LOCAL CAMPAIGN

The Jackson Elementary school began its stream adoption program in 1983. The long-term goal of the project was to reestablish a salmon run in Pigeon Creek which, due to improper development practices in its headwaters, had lost its salmon run 25 years prior. The Adopt-A-Stream Foundation (AASF) got teachers and 400 students at the elementary school hooked on developing a public awareness campaign and restoring salmon to Pigeon Creek.

The ASAAF provided teachers with its clean water curriculum, *Clean Water, Streams and Fish, a Holistic View of Watersheds.* The curriculum is available from the Washington State Office of Environmental Education, 17011 Meridian Avenue N., Rm. 16, Seattle, Wa. 98133; (206) 542-7671.

AASF also provided teachers with assistance developing a long-term action plan and a $1,200 grant to fund a classroom aquarium to hatch salmon and help students learn how to test water quality. Students learned very quickly that it's one thing to hatch fish in a controlled environment and quite another to deal with a wild ecosystem. By the spring of 1984, students released baby salmon into Pigeon Creek with the intention of doing everything they could to ensure that the baby salmon had a place to return to spawn future generations.

With guidance from their teachers, the students devised a plan to make their parents, all residents and businesses in the watershed aware of their goal to restore a salmon run in the creek. First, students prepared a map of the watershed and the creek (a small stream approximately 1.5 miles in length), some facts about its condition, and a statement of the school's goal to restore the salmon run.

The Pigeon Creek watershed information sheet was enclosed in a pamphlet provided by the AASF called *Streams, Guidelines for Survival.* The pamphlet has a variety of hints on how to take care of a stream. (For a copy of the pamphlet, send a request along with 50 cents to AASF, Box 5558, Everett, Wa. 98206.) Students then delivered a packet to every household and business in the watershed, along with a plea for citizen help in restoring the creek by following steps outlined in the pamphlet.

Other activities on the watershed included stream cleanups, storm drain marking, stream identification signs and writing letters to media outlets.

Another effective move in this public awareness campaign came about two years later, when students were granted an audience with the Everett City Council. Prior to the meeting, students sent press releases notifying media about the meeting and its purpose of requesting assistance from elected officials to save Pigeon Creek. On the day of the meeting, representatives from grades one through five attended, and with media representatives in the audience, gave a compelling slide presentation on their efforts to restore the creek. The City Council pledged to do everything they could to help.

Those initial efforts resulted in considerable media attention ranging from local newspaper articles, to national periodicals and television coverage. This continuous public awareness effort led to continued positive results. Salmon returned to the creek in 1987 for the first time in 25 years! And in 1991, the city constructed a storm water control facility that will cure many of the problems that led to the loss of the salmon run in the first place.

The Jackson Elementary School had clear goals, measurable objectives, a date-specific action plan, and a great deal of human resources to fill their budgetary needs. They were, and continue to be, very successful campaigners at the local level using volunteers.

USING MEDIA TO INCREASE PARTICIPATION

The Adopt A Stream Foundation has been involved in getting people interested in adopting streams for 10 years. Building on the print media response to the first 10 projects we initiated in 1981, we were able to get requests for information and support from volunteers wanting to adopt a stream. The print media also led to inquiries from the electronic media, and as a result, we now respond to requests for information around the country.

Before you begin the process of using the media, make sure that you know why you want to use them. Do you want to recruit volunteers to join your group? Recruit volunteers for a specific event? Announce your group has discovered Company X is dumping toxic chemicals into your watershed? You may want different things at different times from the media.

There are several excellent references available that provide the basics of getting free publicity. They also tell you how to write an effective press release and offer additional hints. The *Kids' Guide to Social Action* is a great resource with templates on press releases and a variety of other topics, such as writing letters to the editor, power interviewing, writing petitions and lobbying. To order a copy, send $14.95 plus $2 postage and handling to the AASF, PO Box 5558, Everett, Wa. 98206. Don't be misled by the title, this book is an adults guide to social action as well. In addition, most states and metropolitan areas have a guide that provides a complete list of all print and electronic media in the area. Get one, and keep it up to date as you use it.

PRINT MEDIA

The AASF has been fortunate in that most of its stream restoration and environmental education projects have public interest appeal. It's easy to get a newspaper to publish a photograph of a stream project if that project is correcting a visible problem or if you have kids involved. We also try to provide something different, demonstrate action, show people cleaning up a pollution problem, and occasionally provide a little controversy.

The beauty of print media is that you have a wonderful record of what you've done, and you can use the coverage to get more media involved. Our experience has been very positive when we send a press release about a new project and include a relevant article about a similar project written by another newspaper or magazine. In addition, many weekly papers will print an article prepared by you and include accompanying photographs.

Because newspaper and magazine articles are cheap to reproduce and mail, they are great tools for your environmental education campaign and provide excellent support documentation to any request for funds.

RADIO

Radio stations broadcast community calendars to promote events, and all stations are required to provide a certain number of public service an-

nouncements. In general, radio is much easier to access than television and having your project aired on the radio is a great way to get the word out to the public, particularly if your goal is simply to announce an event.

TV

The AASF has been fortunate that many of our projects have been covered on television. Public access and cable stations are the best outlets for public service announcements with the least amount of work on your part. Regular network TV stations require a lot more lead time and planning. To get a piece on the news it has to have a 30-second punch. To get in-depth coverage, five minutes or longer, on a regular show or PBS film may require several days or even weeks of your time.

You may have to get creative to entice media coverage of your project. If you provide a common story with a different angle, action, human interest and kids, chances are you will be able to use the media; keep the controversy approach in your hip pocket if all else fails.

Remember, the media needs you. They are hungry for good stories. Feed them well and watch your project reap the rewards!

Electronic and print media provide great publicity, but don't focus your media campaign exclusively on the traditional newspaper, radio and TV crowd. As you drive down the road, count how many advertisements you see on the local convenience store, supermarket and sporting goods marquees. You are not the only one who sees them. If you can strike up a good relationship with a store manager, you can get events posted for free and promote your project to thousands who drive by the same road.

FUND RAISING

Elizabeth L. Toler

Virginia Environmental Endowment

Jackie Carrera

Maryland Save Our Streams

RAISING MONEY IN THE '90s

For 15 years I have been in the business of *fund giving* on the staff of a foundation that awards up to $1 million a year in grants for environmental improvement. Virginia Environmental Endowment was created in 1977 as the result of a federal court settlement on the pollution of the James River by the pesticide Kepone, which was manufactured under contract for Allied Chemical Company. With an initial endowment of $8 million dollars paid in the settlement, VEE was created as an independent foundation and is one of the few in the nation that makes grants solely for environmental programs.

VEE has subsequently received federal court settlement funds paid by the FMC Corporation, the Bethlehem Steel Corporation, and the Wheeling-Pittsburgh Steel Corporation. These funds are designated for water quality projects in West Virginia, Kentucky and the Martins Ferry, Ohio region, and for projects related to the effects of toxic substances on the water quality of the Chesapeake Bay. Since 1977, VEE has awarded some $11 million in grants ranging from $1,000 to $250,000.

One key to the success of our grants is our flexibility to provide seed money to grassroots organizations that depend on dedicated volunteers to monitor rivers, speak out at public hearings, present educational programs in local schools, and raise public awareness about environmental issues and solutions. In working with these groups, we urge and advise them to develop long-range fund-raising strategies and to build a broad base of financial support within their communities.

Raising money for environmental projects can be as challenging as saving the rivers. Federal cutbacks in funding in the 1980s and recent budget reductions in many states have put new pressures on foundations, corporations and individuals to increase or re-direct their charitable donations. However, with the recession continuing to take its toll, many donors just don't have as much money to give.

A 1990 study by the Independent Sector reported that 13.4 percent of Americans gave money to at least one environmental organization. However, volunteers to environmental groups expected to give less time in 1991 than volunteers to other groups. This is important because an active volunteer base is very important to fund-raising efforts.

Environmental organizations share some of the blame for the difficulties in fund raising, in spite of an all-time high level of public interest in environmental issues. There are tens of thousands of groups focusing on a wide array of issues — sometimes with conflicting or confusing messages — and competing among themselves for public and private funds. Controversies about environmental crises, jobs and consumer health can cast a clouded public image on all environmental groups.

Although foundations and corporations are giving more money to environmental organizations, they still prefer the traditional causes — education, health and the arts. Foundations and corporations are not, by nature, big risk-takers. There has been a reluctance to get mixed up in the controversial politics of the environmental movement. Grassroots

organizations often lack the financial and management expertise that foundations expect from their grantees. Foundations also assume that these organizations can generate resources from their memberships and, therefore, have less need for grant support. Corporate support most often goes to environmental law or to research groups who won't show up at their headquarters with picket signs or embarrass them in public about poor environmental records.

The prospects for environmental fund raising are not all discouraging, however. According to the Foundation Center, foundations' share of support for the protection of the environment jumped to 4.9 percent in 1989, up by one-fourth over 1988. Out of $122 billion in total charitable donations in 1990, $2.3 billion went to nonprofit organizations active in environmental protection and wildlife conservation. Even after inflation, this was a jump of over 25 percent from 1989.

The proportion of companies that sponsor foundations rose from 42 percent in 1977 to 64 percent in 1989, and many of these foundations now consider environmental nonprofits to be eligible for matching gifts by employees. All of these statistics indicate that environmental groups have good prospects for fund raising.

To follow is a profile of the most likely donor to environmental organizations as reported in 1990 by the Independent Sector. I'll give you the highest percentages within each category:

- 53 percent of donors to environmental organizations are females;
- 55 percent are age 25 to 44;
- 38 percent are college graduates;
- 31 percent earn annual incomes of $60,000 or more;
- 71 percent are married; and
- 33 percent are from the Midwest.

When asked how they decided to give to environmental organizations:

- 29 percent said they decided on their own;
- 28 percent gave because they were asked;
- 28 percent responded to a letter;
- six percent responded to an ad; and
- four percent responded to a telephone appeal.

Just as there are rivers, bays, lakes and oceans to be saved, there are lots of dollars and supporters out there to attract. The competition among other nonprofits is intense, and it is likely to remain so.

EXAMINING FOUNDATION PROSPECTS

According to the Foundation Center, there were 32,000 foundations in the United States in 1989, holding total assets of $138 billion and awarding almost $8 billion in grants.

Independent foundations, which include family foundations, accounted for 76 percent of grant dollars awarded in 1989. Community foundations, which draw funds from many donors, accounted for 5.4 percent of grant dollars awarded and are one of the fastest-growing sectors of philanthropy. Corporate or company-sponsored foundations made 17 percent of the grant awards.

Once you begin sorting through all of the available information on individual foundations to find the most promising prospects — the ones that may be worth your time to pursue — you will find that (1) the choices become much more limited, and (2) the task of identifying them requires a lot of work.

It has been estimated that 93 percent of grant requests submitted each year fail, in many cases because the proposals are not compatible with the program interests or geographic limitations of the foundations that receive them. The challenge is to find those foundations that award grants in the dollar range that you need, for the type of support you seek, for the subject area of your program, and to the type of organization that you are.

Most foundations limit their grants to their local communities or states. Small foundations may support only selected schools, hospitals or charities; or they may give to a wide range of interests. But they typically don't provide much information to the public. Only one-fourth of America's foundations have paid staff. Only 26 percent issue publications about their programs and procedures.

Community foundations, as a rule, focus giving on specific areas or regions. Grants from corporate foundations generally reflect the corporation's in-

terests and are targeted to areas in which the corporation has operations. The larger, national foundations may have grantmaking programs that target a specific region or field, but most of their grants support projects that can be used as national models.

There are many good resources to help narrow down the list of foundation prospects. One of the best services for grantseekers is The Foundation Center. This is an independent, nonprofit, national service established in 1956 to provide accurate information on foundation giving. The Foundation Center operates four major libraries in New York, Cleveland, Washington, D.C., and San Francisco, and a network of 175 information centers throughout the country.

You can also obtain copies of foundations' annual IRS returns from your regional IRS office. Your local IRS office should be able to give you the address for your region and instructions on requesting this information.

Once you've put together a list of foundations that appear to be promising prospects, you narrow it down to those foundations that are the most likely to consider your proposal favorably. Again, the task is to find the right match.

At this point it is a good idea to keep a file on each foundation prospect and update it regularly. Look for news articles on that foundation and the grants it makes. Call or write for an annual report, application form, and other guidelines. If you know organizations that have received grants from that foundation, call to ask them about their experiences. Those organizations might be willing to write a letter of support if you decide to submit a proposal.

An excellent list of questions to use in identifying your best foundation prospects has been developed by the Foundation Center. No matter how worthy your program is or how good your grant proposal may be, it is essential to go through this list in examining each prospect.

Some foundations require a letter of inquiry in advance; others want the full grant proposal. Some foundations prefer meeting together to learn about your organization and offer guidance on whether a proposal would be considered. These decisions are generally guided by the size of a foundation's staff and the number of proposals it receives. Generally this information can be obtained by reading a foundation's publications or calling its office.

KEY ELEMENTS OF A GRANT PROPOSAL

Once you have targeted your foundation prospects and decided to submit a grant request, you must prepare your proposal to convince your prospects that your program is a worthy investment. Peter Drucker has wisely noted that "many nonprofits still believe that the way to get money is to hawk needs, but the American public gives for results." (*Wall Street Journal,* 7/11/90). In preparing your proposal, keep this advice in mind.

Before we review the basic elements of a grant proposal, I want to give you a list of what I call the Seven C's of a good request.

The first C is Compatibility. The greatest pet peeve of foundation staffers is receiving a proposal that is grossly incompatible with their stated purposes, interests, grant policies, grant size and geographic limitations.

The second C is Clarity. Make your proposal brief, clear, accurate and specific. Avoid jargon or highly technical terms. Put the request up front, and ask for a specific amount. To say that you will take "just any amount you will give us" doesn't show much planning on your part. If you're asking for operating support, say so. Don't call it a special project if it's not.

The third C is Contribution. Again, focus on goals, measurable objectives and results. Be specific about how you will achieve them. Don't use emotional appeals. Your proposal should be a well-documented statement of facts.

The fourth C is Credibility. All donors must be convinced that the people involved in your organization and its projects are well-qualified and will use grant funds wisely to do what you have proposed. They look at your experience, your management capabilities, and your credibility in the community.

The fifth C is Cost-effectiveness. Foundations usually have a lot of experience in reviewing balance sheets and evaluating project budgets. Your budget

should be a realistic estimate of expenses — don't pad it, and don't cut it so short that you can't carry the project through. Consider all available opportunities to minimize costs.

The sixth C is Cooperation. Many foundations believe that broad community participation increases the potential for a project's success and continuation after the grant ends. Be sure to describe how your project relates to similar efforts in the community, your group will coordinate with those efforts and your contributions will be unique.

The seventh C is Commitment. Potential donors must be absolutely convinced that everyone involved in your organization, from your board members to your volunteers, is fully committed to carrying out your mission and your project.

There are also books available on how to write a proposal. Remember, however, that the application procedures and formats vary with each foundation. If you fail to follow these procedures or don't comply with the application deadlines, your proposal may be automatically rejected.

Some foundations provide application forms. Others are very specific about proposal length, format, contents, budgets and cover letters. Don't send a lot of extra materials that aren't requested. Proofread carefully. Check your math. And don't provide conflicting information.

If you decide to send a standardized proposal to more than one funding source, be sure to tailor a cover letter to each one, addressed to the correct contact, and making a case for why that foundation should consider your proposal in light of its special interests.

Let me very briefly review the basic parts of a grant proposal that most funders expect to see:

A Cover Letter – On letterhead stationery, if available, and signed by your organization's chief officer or board chairman. This should highlight the points of your project that would be of interest to the foundation and state the amount being requested;

A Table of Contents – To help organize your presentation;

A Summary of the Project – To describe the purpose of the project, the total budget and the amount requested, the plan of action, and the anticipated results;

An Introduction to Your Organization – To describe the mission of your organization, provide a brief history of your activities and accomplishments, list your officers and board members, and describe the qualifications of the project staff;

A Problem Statement – To describe the specific problem or need your project will address, who will benefit, what other related efforts are being made, and how your project will be unique;

Goals and Objectives – To describe the measurable results you hope to achieve;

A Specific Plan of Action and Project Schedule - To list the tasks that will get you to your results;

An Evaluation Plan – To describe how you will measure the success of your project and evaluate what worked well and what didn't;

The Project Budget – To provide a realistic estimate of project costs. List all sources and amounts of committed and anticipated income and a breakdown of expected costs by major expense categories. Identify which of the costs would be covered by a grant from the foundation. Many foundations also require a copy of your total operating budget or an audited financial statement.

Future Funding Plans – To describe specific plans for supporting the project after the grant support ends. This is where your long-range fund-raising strategy is helpful.

WHAT HAPPENS NEXT?

After submitting a proposal, if you have not received an acknowledgement in a few weeks, call to be sure your materials were received and to ask if any additional information is needed. If you aren't sure about when you should expect to receive a decision on the proposal, by all means ask. If you have not met with the foundation's staff previously and can make the trip to its office, you might suggest an appointment to discuss your project.

As anyone in the fund-raising business can tell you, you may hear "No" more often than you hear "Yes." The process of seeking grants takes time and energy. But don't let a rejection dampen your enthusiasm.

In many cases, a foundation's decision on a particular grant application may be dictated by the amount and type of grant commitments it currently has, the number and type of proposals it has received, the effect of economic trends on its available assets, and recent developments in public policy and legislation.

KEEPING DONORS INFORMED AND GIVING

Once you've devoted so much time and effort to gain a new donor, it is extremely important to keep that donor informed about your program, especially if you want to get continued support.

The first and most simple step is to write a thank-you letter to the donor. You should acknowledge the efforts made by people who helped you contact that donor or who wrote letters of support. You should also clarify your responsibilities as a recipient of a donation or a grant, and make sure that everyone on your staff or your board who has a role to play is aware of these responsibilities. If you have a foundation grant, find out if there are specific forms, procedures and deadlines for reporting progress, expenditures and results. If you proposed an evaluation process, get it into place.

Most foundations and corporations appreciate acknowledgement of their support in press releases, publications and reports about your program or organization. Some will offer to help with publicity. Other donors, particularly individuals, prefer not to have their support publicized. In either case, ask permission before making information public.

Good public relations is an ongoing process. By making an effort to publicize your events, the donors see that they have funded a successful project. Donors realize that publicity is important in recruiting citizens and volunteers to participate in community environmental programs. You should cultivate and educate your local reporters and invite them to participate in your program or in special events.

Regular meetings with your donors, whether they are your members or community business leaders or foundations, are recommended. How often and how long these meetings are depend on the donor's interests and schedule. These meetings offer the opportunity to discuss project results as well as new plans. They can also provide leads to new potential donors or community partners.

Cultivating current donors is an ongoing process of education — for you as the fund raiser and for the donors. You are learning more about what donors care about and what they want to do with their money, and they are learning what you can do for them and for their community.

For all of these tasks, it is important to keep good records on your fund raising, on your project's activities and results, and on any new contacts you make that are potential new donors. Keep files of all press clippings, photographs, videotapes and slide programs about the project. These files will be useful in preparing new fund-raising campaigns and grant proposals.

REFERENCES

The Chronicle of Philanthropy, Vol.III, No.16, June 4, 1991, "1990 Giving: Smallest Increase in Years," Stephen G. Greene.

The Chronicle of Philanthropy, Vol.IV, No.1, October 22, 1991, "Corporate Giving: Still Stalled," Jennifer Moore.

The Foundation Center, 79 Fifth Avenue, New York, NY 10003-3050; 800-424-9836. Catalog of books available.

The Council on Foundations, 1828 L Street, NW, Washington, DC 20036; 202-466-6512.

Environmental Grantmakers Association, 1290 Avenue of the Americas, New York, NY 10104; 212-373-4260.

Grantsmanship Center, 1031 S. Grand Avenue, Los Angeles, CA 90015; 213-749-4721.

The Wall Street Journal, July 11, 1990, "Despite Appeal, Saving the Earth Lacks Donors," Dana Milbank.

CITIZEN PARTICIPATION IN THE CLEAN WATER ACT

Presenters: Diane Cameron, National Resources Defense Council; and Roberta Savage, America's Clean Water Foundation.

Diane Cameron

National Resources Defense Council

VOLUNTEERS: THE FRONT LINE OF THE CLEAN WATER MOVEMENT

The Natural Resources Defense Council (NRDC) is spearheading the National Clean Water Network, which is composed of over 260 grassroots, state and national organizations working together for a strengthened Clean Water Act. The network is diverse; it includes commercial fishing associations, trade unions, religious and social justice organizations as well as environmental groups.

The National Clean Water Network has a basic three-part agenda: prevent, protect and enforce. We want to prevent pollution at its source, regardless of whether it is raw sewage from combined sewers or leaking sanitary sewers, pesticides and manure in farm runoff, or toxics in factory discharges. We want to protect critical aquatic ecosystems including wetlands and reparian habitats that are essential for the survival of fish, amphibians, birds and other aquatic-dependent species. We want to ensure that the public is notified of water-pollution problems through posting requirements at beaches, factory and sewage outfalls, and we want to make sure that the nation's waters are protected through well-targeted monitoring and enforcement programs.

High on the Clean Water Network's agenda is runoff policy: the need to tackle land-based sources of water pollution, like overuse of nitrate fertilizers that contaminate surface and groundwater, manure runoff from dairy operations, siltation from logging, row cropping and construction sites, and pesticides from farms and lawns. Many state water-quality agencies have longstanding water—quality protection programs based on traditional point sources: factories and sewage plants. Although the work in reducing these pollution sources is not yet over, we have come a long way in controlling these sources through the National Pollutant Discharge Elimination System. We have barely begun, however, to establish water-quality practices for land-based sources of water pollution.

We need to create a program that will make states accountable for restoring and protecting watersheds, and that will establish the responsibility of land operators to use water-sensitive management measures. The 1990 amendments to the Coastal Zone Management Act establish similar state and land operator responsibilities in coastal areas; we simply want to expand this runoff policy to watersheds nationwide.

As the nation turns its attention to land-based sources of water pollution, we realize that we need to create and revise state monitoring programs so that they provide an accurate picture of polluted runoff problems and sources. Volunteer monitors are now providing one of the few strong links in a currently weak monitoring chain. Volunteer water-quality monitors, especially those who work through organizations like the Izaak Walton League's Save our Streams Program, are on the front lines of the national movement for watershed restoration and protection. Virginia is just one example of a state where volunteer monitors are an integral part of watershed assessment for runoff-related water-quality problems. Without the hundreds of volunteers

who are now looking at the effects of building construction, farming and logging on lakes and streams, Virginia's watershed assessment would provide a less-accurate picture of watershed health.

We propose that state polluted-runoff programs (319 programs) receive greatly expanded authorizations and appropriations from Congress — on the order of a five-fold increase from the current average of less than $1 million per state per year — so that state water-quality staff can do the watershed monitoring and assessment, the cooperatiave agreements, and the program implementation that will get our waterbodies back to full health. We also propose that states be required to include a small but significant part of their runoff program budgets for training and equipping volunteer monitoring data for use in their biennial 305(b) reports to EPA and Congress. We welcome any citizen support for this proposal, so that volunteer monitors can work with state water-quality agencies as full partners in watershed restoration and protection.

Roberta Savage

America's Clean Water Foundation

HISTORY OF CLEAN WATER LAWS

The first major piece of clean water-related legislation was the Rivers and Harbors Act of 1946. This statute incorporated the water-quality standards structure we use today and provided small grants for the construction of local sewage treatment plants.

In 1972, the first major law regulating the discharges into our nation's waters was passed, the Federal Water Pollution Control Act Amendments, Public Law 92-500 (Clean Water Act).

This comprehensive legislative framework provided, among other things:

- A goal of fishable, swimmable waters;
- A goal of zero discharge of pollution into the nation's water;
- Grants for local wastewater treatment facilities at $5 billion annually;
- Community grants for area-wide planning;
- A permitting structure to regulate industrial and municipal discharges;
- Effluent guidelines for categories of industries;
- Constraints on dredging and filling of waterways;
- An enhanced scheme for development and implementation of water quality standards.

Congress re-examined the statute in 1977 and added new provisions for toxic controls, sludge management, stormwater controls and pretreatment of industrial waste. Congress also re-emphased the strong role they expected the states to play in managing the Clean Water Program.

In 1981, with the election of Ronald Reagan as president, a new federalism approach was applied to the Clean Water Act. The president refused to call for a budget allocation unit unless specific reforms were enacted by Congress.

These reforms included cutting the budget for clean water by more than half and limiting the categories of cleanup eligibility for federal funding.

With the program, in essence, running at half speed, Congress once again examined the Clean Water Act, passing a bill to establish State Revolving Funds (SRF) to assist local governments with wastewater treatment needs. The 1986 Clean Water Act also incorporated expensive programs for stormwater runoff, toxics and nonpoint sources of pollution.

President Reagan vetoed the bill, forcing Congress to pass it again in 1987. Once again President Reagan vetoed it, but Congressional Override made the 1987 Clean Water Act a law.

The twentieth anniversary of the original Clean Water Act, 1992, is also a time to examine the statute. Key issues this time around include:

- SRF
- Wetlands
- Combined sewer overflows
- Nonpoint sources
- Water quality standards

- Funding
- Pollution prevention

POINT AND NONPOINT SOURCES

Water quality is an integral part of water development, and point and nonpoint controls must be developed in sync with your water development plans. Throughout the nation, we have made great strides in improving water quality. Rivers and lakes once devoid of aquatic life now boast diverse populations of fish and other aquatic critters. More than 120 billion dollars have been invested in improving water quality. Most sewage treatment plants are meeting secondary treatment. Most industrial facilities are meeting permit limits, and most streams are in reach of meeting standards.

In a presidential election year it is unlikely that the Clean Water Act will pass. And with the expectation that there will be a host of new Congressional members elected in November, we may still be talking about Clean Water Reauthorization in 1995. Who knows?

RIVER AND STREAM MONITORING TECHNIQUES

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WHAT ARE BENTHOS AND WHY USE THEM?

Benthic macroinvertebrates (benthos) are animals without a backbone that live in surface water, depend upon the bottom material for food and/or shelter, and are usually easy to see. The most common groups of benthos include insects, clams, snails, worms and crustaceans. Many benthos have life cycles that require them to live in the water for their entire existence (crayfish, riffle beetles), while others have cycles that require them to eventually leave the water permanently to feed and/or reproduce (mayflies, dragonflies). Benthos are important in the ecological food chain since they provide food for other animals (fish and other benthos) and they recycle parts of dead animals and other types of organic matter (crustacea and worms).

Benthos have been used for over 100 years to detect pollution in streams and rivers. By the accumulated years of knowledge of collecting benthos and recording the environmental conditions in which they were found, biologists and others were able to estimate the quality of rivers or streams by knowing which benthos were present (with proper identifications), and in what abundances they expected to find under the different water quality conditions. As these indicated conditions anywhere between pristine and severely polluted, their value to scientists grew and have become a part of many pollution-control programs to complement existing chemical and toxicity testing efforts.

With greater amounts of pollutants to worry about and the grab-sample nature of chemical and toxicity testing, biological monitoring using benthos and fish communities is increasing in popularity. Today, EPA requires all states to adopt narrative and numerical biocriteria, based upon habitat, benthos and/or fish, in their water quality standards. This integrated approach to protecting our water resources has resulted in extraordinary revelations of water quality problems where either we did not think they existed or where we did not have the time or money to sample.

WHY ARE CORRECT IDENTIFICATIONS IMPORTANT?

Accurate identification of benthos is not just an issue that professionals can use to nit-pick. Regardless of the level of taxonomy (a named group of any organism is called a taxon), it should be accurate. For educational situations and quality assurance program needs, correct identification shows care and pride in your work and earns respect from your students and colleagues. Correct identifications are essential if the data will be used to influence local or state decisions, whether they are applying corrective actions or to prompt additional monitoring and

investigation by agencies. Provisions for ensuring correct identifications through training and establishment of a voucher collection are an essential part of the Quality Assurance Program Plan. An excellent way to ensure this occurs is to establish a training program as part of the overall Quality Assurance Program.

HOW ARE BENTHOS CLASSIFIED?

Benthos are classified according to international rules of nomenclature starting at the largest classification (Kingdom, Animalia) and proceeding to the lowest common classification (Species, *Hexagenia limbata*) as follows: Kingdom_Phylum_Class_Order_Family_Genus_Species.

Generally, the largest classification level used for water quality assessments are Class and Order. The smaller classifications can usually tell you more about the specific environmental requirements of the taxa (plural of taxon). Whereas species-level classifications yield a great deal of assessment information on chironomidae (midge larvae) and oligochaeta (worms), species level identifications are currently not as useful on many of the other groups of benthos. It is very common for some state assessment programs to identify some benthos to Class, others to Order, Family, Genus, or Species, depending upon the water quality assessment information each level can provide for specific taxa. For example, EPA's *Rapid Bioassessment Protocols* use predominantly Class and Order for level I, Family for level II, and Genus/Species for level III (Plafkin et al. 1989). The level of taxonomy is related to the objectives of the program, resources available, and the taxonomic expertise on hand. The more rigorous field and taxonomic efforts generally afford more flexibility in how the information is applied. The important consideration here is to apply a consistent classification scheme for all of your efforts.

HOW AND WHERE ARE BENTHOS COLLECTED?

Benthos are collected by methods commonly referred to as qualitative and quantitative methods (Klemm et al. 1990). Quantitative methods use sampling devices that allow for establishing the exact number of organisms per unit area of substrate sampled or organisms collected per time (drift net samplers). Typical quantitative sample devices include Surber samplers (riffles and shallow), artificial substrates, and grab samplers such as Ekman and Ponar samplers (Klemm et al. 1990). Qualitative sampling usually focuses on obtaining as many different types of benthos as possible with little regard for collecting numerically representative samples. This type of sampling is very popular due to the relative ease and flexibility for collection. The primary sample device for qualitative collecting is the long-handled dip-net and kick-seine of almost any variety. Hand picking is also very popular, especially for volunteer programs that want everybody to get into the action. A good example of a program using qualitative sample methods is EPA's Rapid Bioassessment Program (Plafkin et al. 1989), and one of the best biomonitoring programs in the country uses a combination of artificial substrates (quantitative) and dip-netting (qualitative).

The riffle/run portion of the stream is commonly called the most productive portion of the system and where the most diversity of benthos will be found. There is a great amount of microhabitat in riffles for benthos, an ample oxygen supply, and a good chance for access by monitors. Therefore, sampling in the riffle/run will suffice for most water quality assessments. However, if there are no riffle/runs available, habitat may become a limiting factor and other habitat types may need to be sampled (such as undercut banks, overhanging vegetation, pools, and any part of the stream bottom that may be accessible). Plafkin et al. (1989) and Klemm et al. (1990) provide excellent discussion of this topic.

HOW ARE BENTHOS IDENTIFIED?

Before actual identifications can be made, you must decide whether you will identify the benthos in the field or in the laboratory. Many volunteer programs rely upon field identifications (Illinois, Ohio, Izaak Walton League of America —IWLA) with the organisms collected returned to the stream. Other programs primarily depend upon laboratory

identifications with some cursory field identifications (Maryland). A program with a good Quality Assurance Program will have some facets of laboratory identifications for general education, specific training, and performance evaluation of monitors (IWLA). Whether laboratory or field identifications are made will depend upon available resources and the objectives of the program. At a minimum, a voucher collection of the benthos collected from the study area should be made and verified in a laboratory.

Benthos are best identified by either a picture key (for the higher levels) or a dichotomous taxonomic key which contains generic and specific descriptions of certain characteristics of the benthos complemented by illustrations. In a dichotomous key, benthos are identified to different levels by comparing physical features and selecting one of the two numbered descriptions that best fits the specimen you are examining. This process continues until the specimen is correctly identified. There are a number of excellent taxonomic keys to choose from which approach the topic from many levels. Selecting the best key for you will be based upon personal experience and word-of-mouth from your colleagues or other professionals. Klemm et al. (1990) provide a comprehensive listing of available keys.

DEVELOPING YOUR OWN TRAINING SYSTEM

It is important to ensure that all volunteers in the program are adequately trained to not only identify the benthos, but collect them and establish a training system. Training systems can be used for introducing this topic to new volunteers, to specifically train and test the volunteers for their proficiency in identifications, and to periodically freshen-up existing participants on an annual basis. The training system should contain a collection of preserved representative benthos which could also serve as a voucher collection for quality assurance needs. An obvious first step is to contact other volunteer monitoring organizations for a description of their protocols and overall advice. Discussions with the state or local water quality agency and local colleges or universities also provide a great deal of insight which can turn into actual assistance.

The Izaak Walton League has an excellent VHS-video on collection of benthos that touches upon identification, and the EPA offers a VHS-video on their *Rapid Bioassessment Protocols* which goes into detail on dip-net collecting, stream dynamics and habitat assessment. The identification of the benthos is much more difficult to learn from watching a video. Benthos should be collected and ideally preserved in a 70 to 80 percent ethanol solution, although sometimes isopropyl alcohol is used. Each type (or taxon) of benthos should be preserved and labelled in individual vials for ready reference. Although there are a great deal of taxonomic aides available, none of them can replace actual experience. We strongly suggest teaming up with individuals or organizations with existing experience in identification. If this is not possible, many volunteer organizations have easy to use taxonomic keys (McDonald et al. 1990) and there are many useful professional taxonomic aides (McCafferty 1981). Please refer to Klemm et al. 1990 for a listing of equipment suppliers as well as an exhaustive list of taxonomic references.

WHAT DO WE DO WITH THE DATA?

It is very important to properly document all of your results including the location (description as well as station number), date and time the sample was collected, the date that the sample was identified and the names of the individuals who collected the data and identified the benthos. This information should not only be documented in either report form or electronic format, but the information should also be stored with the samples themselves. Data sheets should be developed to meet your specific needs and be available either to include in reports, transpose into electronic media, or to send a copy to interested parties.

Data can be evaluated in several manners (Klemm et al 1990). Evaluation options include using indices such as biotic, diversity, similarity and composite indices such as the *Rapid Bioassessment Protocols* (Plafkin et al. 1989) and various enumerations or counts of organisms. Functional feeding group in-

formation has also become popular and will become subject to additional evaluation. It is important not to rely upon a single measurement value for your final assessment. It is best to use a multiple- metric approach outlined in Plafkin et al. (1989) and utilized by many state programs. The data, if properly documented and conforming to the Quality Assurance Plan, can be used by government agencies, basin commissions, local councils/groups, watershed councils and state regulatory agencies for their biennial Section 305(b) reports, mandated by the Clean Water Act, which document the quality of the water resources throughout each state. Working with the intended user of the data prior to initiating data collection is the wisest time-saving measure you can utilize.

REFERENCES

Klemm, D.J., P.A. Lewis, F. Fulk, J.M. Lazorchak. 1990. Macroinvertebrate Field and laboratory methods for evaluating the biological integrity of surface waters. USEPA, ORD, Cincinnati, OH, EPA/600/4-90/030. 256 p.

McCafferty, W. P. 1981. Aquatic entomology: the fisherman's and ecologist's: Illustrated guide to insects and their relatives. Science Books International, Boston, MA.

McDonald, B., W. Borden, and J. Lathrop. 1990. Citizen stream monitoring: A manual for Illinois. Illinois Department of Energy and Natural Resources. Springfield, IL 35 pp. (217-785-2800).

Merritt, R.W., and K.W. Cummins (eds). 1984. An introduction to the aquatic insects of North America. 2nd edition. Kendall/Hunt Publ., Dubuque, IA. 441 p.

Ohio Environmental Protection Agency. 1990. The use of biocriteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, OH.

Ohio Environmental Protection Agency. 1989. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, OH 43212.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughs. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. USEPA, Office of Water, Washington, D.C. EPA/440/4-39-001.

Rankin, E.T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio 43212.

U.S. Department of Agriculture. 1989. Fisheries Habitat Surveys Handbook (R-4 FSH 2609.23), Forest Service Intermountain Region, Ogden, UT.

U.S. Environmental Protection Agency. 1990a. Biological criteria: national program guidance for surface waters. USEPA, Office of Water, Washington, D.C., EPA-440/5-90-004.

U.S. Environmental Protection Agency. 1990b. Volunteer water monitoring: A guide for State managers. Office of Water, Washington, D.C. EPA-440/4-90-010.

LAKE MONITORING TECHNIQUES

*Presenters: Carolyn Rumery Betz, Wisconsin Self-Help Lake Monitoring Program; Scott Kishbaugh, New York State Department of Environmental Conservation; and Sandra Fisher, University of Florida.**

Carolyn Rumery Betz

Wisconsin Self-Help Lake Monitoring Program

LAKE MONITORING TECHNIQUES: THE NEXT GENERATION

Once the decision is made to expand a monitoring program, the first step is to develop specific criteria for the selection of possible tests. Criteria that can be used to select tests are: low technology and low cost equipment; yield on-the spot results as often as possible; satisfy the interests of volunteers; and fulfill some of the administering agency's data needs. It is also useful to research other states' programs and administer questionnaires to the affected volunteers and agency staff. Using these criteria and procedures, the Wisconsin Self-Help Lake Monitoring Program selected new tests to be included in its 1990-91 Expanded Pilot Program: dissolved oxygen, temperature and pH profiles, phosphorus and chlorophyll samples, and precipitation.

Start on a pilot basis so sampling equipment and procedures can be thoroughly tested and refined before too much time or money is invested or volunteers are trained in techniques that must then be modified. The key ingredient to a successful program is a complete training manual explaining the reasoning behind the program components and step-by-step procedures to be followed. Our training manual is in a three-ring binder style notebook allowing for greater flexibility when (not if) program procedures change. Include photographs if possible. (We use color xeroxes, which are easy to reproduce.) A training session at each volunteer's lake at the beginning of each season is recommended to familiarize the volunteer with the equipment used, demonstrate proper sampling procedures, and acquaint the volunteer with the training manual.

In addition, our program does not charge its volunteers for any of the costs involved and provides each lake with about $200 worth of equipment.

A comprehensive quality control/quality assurance program should be designed and implemented in conjunction with the new program to verify results, modify procedures as needed and demonstrate the accuracy and reliability of the data to agency personnel or others. Our quality assurance program has volunteers take duplicate samples of the data they collected for one of the five months they sampled. In addition, a DNR field technician visited a representative number of lakes in the program. While in the same boat as the volunteer, the technician took concurrent samples using DNR equipment. All data sets were statistically analyzed and used for program recommendations.

WATER QUALITY PROFILES

The most informative sampling regimes take water profiles, samples or measurements, at incremental depths from the surface to the lake bottom. The depths to be sampled should include the rapid changes that occur around the thermocline, but should limit the number of samples to that which can be accurately completed in a reasonable time. The sampling intervals should be based on historical data for your state using lakes with similar depths.

**Transcript Unavailable*

Those programs that want to collect profile samples need to obtain a water sampler, either by developing one or purchasing a commercially made sampler (about $60 to $300). If dissolved oxygen samples are taken, a bottle (60 millimeter if using a DO kit) should fit inside the sampler so that when the sample is brought to the surface, it is not contaminated with atmospheric gases. The 60 millimeter bottle must flush a minimum of three times to obtain a sample representative of a specific depth. The Wisconsin Self-Help Water Sampler may serve the purpose of some programs if most of the lakes are under 45 feet deep. A modified version of the sampler may be more suitable for intensive sampling efforts or for lakes deeper than 45 feet. LaMotte Company and Aquatic Research Instruments sell several samplers that are relatively inexpensive and suitable to volunteer monitoring programs.

DISSOLVED OXYGEN

Dissolved oxygen (DO) is essential to fish and other aquatic organisms. Since electronic meters, which usually cost at least $1,000, are financially prohibitive for most volunteer monitoring programs, the alternative is to use a modified Winkler test kit available through many scientific instruments companies. Many programs use the kit developed by the LaMotte Company (Model 7414/EDO) since it is EPA approved.

To test for accuracy, volunteers air saturate a pint of distilled water and titrate three aliquots of the sample. By knowing the temperature and altitude, we can look up the expected saturation level and compare that number to the results obtained by the volunteer. Great differences between the expected and achieved results can help identify a volunteer that is having problems with the techniques.

Implementation of our quality assurance plan led to the discovery of some systematic errors that were easily corrected by modifying the test kit. The kit's glass vial for measuring 20 millimeters of fixed sample was replaced by a small graduated cylinder and eyedropper, which enabled more accurate transferal of fixed sample to be titrated. Many of the volunteers had not been reading the meniscus properly using the glass vial provided in the kit, resulting in a smaller volume of sample being titrated.

The second modification was adding a 20-gauge hypodermic needle (with the tip filed down) to the glass syringe used for the titration. While the syringe is divided into .2 milligrams per liter increments, each drop delivered may represent as much as .6 milligrams per liter. If the titration is carried out to the nearest drop, accuracy of plus or minus .6 mg/liter is the best attainable. The addition of the needle allows for increments of .1 mg/liter to be delivered, resulting in a more precise final reading.

Once modified to our specifications, the kit fell within an acceptable statistical confidence limit.

TEMPERATURE

Temperature data are critical in determining whether or not a lake stratifies. Stratified lakes may suffer from low or no oxygen conditions at depth, and with potential release of phosphorus from bottom sediments. Shallow non-stratified lakes may suffer from fish kills. A temperature profile is used to locate the thermocline, if one exists.

Thermometers can be used to monitor the temperature of the water throughout the profile if a discrete sampler is used to collect a water sample. Most thermometers suitable to volunteer programs are inexpensive and readily available through scientific instrument companies. Since thermometers break easily, it is advisable to use alcohol and mineral spirits rather than mercury thermometers. Other options are stainless steel, dial-face thermometers which are easy to read and much harder to break.

Before use, every thermometer should be calibrated in the laboratory against a liquid-in-glass thermometer certified by the National Bureau of Standards. Correction factors for each thermometer based on linear regression can then be applied to the temperatures reported by volunteers. Also, keep in mind that depths sampled during summer months may not be appropriate for the fall turnover. In most cases, the thermocline migrates downward, making an accurate electronic thermistor an alternative method for taking temperature profiles. Given a long enough cable, the lake temperature profile can be obtained quickly. With this

information, the volunteer can calculate if and where the thermocline exists and decide where the dissolved oxygen samples should be obtained.

Thermistors available through scientific instruments companies should be approached with caution, since they may be either very cheap, inaccurate, or more expensive than necessary. The New Hampshire Lakes Lay Monitoring Program has had electronic thermistors made for them in bulk.

pH

Field pH can be measured with equipment ranging from litmus paper familiar to most elementary school children to sophisticated electronic meters that are temperature compensated. A compromise readily available now are the pocket-sized pH testers using a sealed combination electrode (Cole-Parmer is one distributor). These should be standardized by the volunteer with a pH 7 buffer solution before each sampling episode, using the set screw in the back of the meter. Newer meters are now available at a slightly higher cost that are temperature compensated and standardized against both low and high buffer solutions.

According to the manufacturer, pH meters are not intended to be used for more than one sampling season and should be replaced each year. Since we felt it was costly and wasteful to purchase disposable meters, and the data generated were of dubious quality, we decided to drop pH. Perhaps the new pocket probes that are temperature compensated and standardized against two buffer solutions yield more accurate results.

PHOSPHORUS

Phosphorus is a nutrient that sustains aquatic vegetation and algae. Phosphorus is an excellent parameter to measure as part of a volunteer monitoring program, particularly if the trophic state index of the lake is to be calculated. However, phosphorus analysis in most cases must be done by a laboratory.

Volunteers should collect two phosphorus samples: one foot below the surface and one or two feet off the lake bottom. The samples are usually preserved with liquid sulfuric acid (premeasured and contained in glass ampules) and mailed to a laboratory for low level analysis. Special styrofoam boxes with the necessary sample bottles and postage already affixed should be provided. Volunteers must be instructed to rinse the jar thoroughly with distilled water before collecting each sample. They should also be provided safety gloves and goggles for the administration of acid. The Florida Lakewatchers do not use acid, but instead freeze their samples and hand deliver them to the lab.

Finding the correct depth at which to collect the near-bottom phosphorus sample can be quite difficult, particularly for volunteers without a depth finder and for those with very deep lakes. On shallow lakes, volunteers can use the Secchi disc or anchor line to determine the depth. If the sampler hits bottom when collecting the sample, the volunteeer moves the boat a few feet away and repeats the sample to avoid contamination with bottom sediments.

CHLOROPHYLL

Chlorophyll data can be used to estimate how much algae is in a lake, and the results can also determine the trophic state index of a lake. Some programs have volunteers collect integrated samples for chlorophyll analysis while others collect a discrete sample from one depth (we use three feet). In Wisconsin the volume of water collected is based on the Secchi depth. Volunteers use hand-operated vacuum pumps and filter their samples through a magnetic filter funnel into a larger receiving flask using glass microfiber filter paper. Once the sample is filtered, the filter paper is folded in half and patted dry in a paper towel. It is then placed inside larger filter paper which has been labeled with the lake name, the date and volume of water filtered. This is closed with a plastic paper clip and dropped into a one-liter Nalgene bottle filled with two inches of silica desiccant gel. This bottle, to which samples are added each month, is frozen until the end of the sampling season when the samples are delivered to the DNR office for analysis.

VOLUNTEERS' OPINIONS

Besides assuring the validity of the data collected

by volunteers, it is equally important to ask volunteers what they think of the program. At the end of each sampling season, a questionnaire should be administered to the volunteers asking their opinions of the various components of the monitoring program and soliciting their suggestions for improvements. Our program was changed to incorporate many of the ideas expressed in this questionnaire.

CONCLUSION

Volunteer lake monitoring programs can be successful ways of collecting valuable, credible data on hundreds of lakes in a state. Volunteers exhibit tremendous enthusiasm toward these programs and are committed to making them successful. We believe volunteers are capable of collecting high-quality, reliable data that will ultimately be useful for management purposes.

ACKNOWLEDGEMENTS

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REFERENCES

American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1989, 17th ed. Standard Methods for the Examination of Water and Wastewater.

Betz, C.R. and P.J. Howard. 1990. Expanded Self-Help Lake Monitoring Program Training Manual. Wisc. Dept. of Natural Resources. PUBL-WHERE-258 90.

Betz, C.R. and J. Schloss. In press. Cent-saving Samplers, Secchis, and 'Scopes. Presented to the Third National Volunteer Monitoring Programs Conference, Annapolis, MD, April, 1992.

Canfield, D. 1991. Professor, University of Florida. Personal Communication.

Lind, O.T. 1974. Handbook of Common Methods in Limnology. The C.V. Mosby Company. St. Louis.

Rumery, C. and J.G. Vennie. 1988. Wisconsin's Self-Help Lake Monitoring Program: A review of the first year - 1986. in Lake and Reservoir Management 4(1): 81-86.

Shaw, B., C. Mechenich, and L.L. Klessig. 1989. Interpreting Lake Water Quality Data: A Citizen's Guide. University of Wisconsin-Extension and College of Natural Resources.

Smeltzer, E. and S.A. Heiskary. 1990. Analysis and applications of lake user survey data. in Lake and Reservoir Management 6(1): 109-118.

U.S. Enivronmental Protection Agency, and Rhode Island Sea Grant College Program. April 1990. National Directory of Citizen Volunteer Environmental Monitoring Programs. 3rd ed. Office of Water. EPA 503/9-90-004

Wetzel, R.G. and G.E. Likens, 1979. Limnological Analyses. W.B. Saunders Company, Philadelphia.

Wisconsin Department of Natural Resources. June 1988. Draft 2nd Edition of the Field Procedures Manual.

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USING VOLUNTEERS TO MONITOR AQUATIC VEGETATION

As rooted aquatic vegetation growth becomes more prominent, perceptions of lake water quality are adversely affected. Other water quality changes that occur attendant to macrophyte growth may also affect perceptions of water quality (such as increased phytoplankton growth, organic deposition and odors). Aquatic plants play an important role in both the health of the lake ecosystem and the overall perception of the lake. Since many lake residents equate excessive plant growth with poor lake conditions, aquatic vegetation sampling should identify those plant species which provide the most excessive growth (the dominant species in a lake plant community).

Although aquatic plant growth greatly influences assessments of the condition of the lake, the relationship between the aesthetic quality of the lake and plant growth is not as clear. For this reason, aquatic vegetation sampling should focus on those plants which most adversely affect the well-being of a lake. In New York, there are four major nuisance aquatic plant species. These exotic species, not indigenous to the lakes of the state, have the greatest potential for disrupting a lake ecosystem due to the nature of their growth patterns. Since use of the lake

is also of paramount concern, vegetation sampling should also be concentrated in those areas in which the greatest recreational impacts can occur: near swimming beaches, boat launch sites and well-trafficked areas. Not coincidentally, these are also the areas in which the most significant plant growth of non-native species does occur.

The proper control of nuisance aquatic vegetation within a comprehensive lake management plan requires knowledge of overlying water chemistry, the presence and relative abundance of individual plant genera or species, length of growing seasons, characteristics of the plant growth media and overall plant community dynamics. Most lake associations or local communities attempt to manage aquatic vegetation with only a small piece of this knowledge.

USING VOLUNTEERS TO SAMPLE AQUATIC VEGETATION

There are many difficulties inherent in the development of a standardized comprehensive vegetation survey using volunteers. Quantitative estimates of biomass, variability, and abundance of aquatic vascular rooted plant species require equipment and personnel for setting transects and sampling quadrants, biomass sampling, bed demarcation, surveying, plant tagging and identification, tissue analysis, sediment sampling, water chemistry and additional environmental measures. Most volunteer groups do not possess the manpower or expertise to undertake extensive surveys, or the management budgets to contract for these services. The difficulty in providing adequate, yet simple training, and the potential liability associated with scuba work, places such extensive surveying beyond the scope of most lay monitoring programs.

However, even a simple vegetation sampling program can generate some useful information for volunteers, the local lake community, and the state agency or organization conducting the program. For example, the New York Citizens Statewide Lake Assessment Program (CSLAP) generates qualitative data that has greatly extended the mapping and collection capabilities of state agencies such as the New York State Department of Environmental Conservation (NYSDEC), especially in low profile or remote lakes.

CSLAP began in 1986 as a lay monitoring program to regularly collect water samples and measure standard water-quality indicators. Currently the program involves nearly 100 lake associations throughout the state. In addition to water quality, CSLAP also participates in an aquatic vegetation sampling program to identify important plants within their lakes, assess the health of the plant community and improve existing plant control strategies.

In developing the vegetation survey component of CSLAP, the NYSDEC had to balance the rigid data collection requirements of the state agencies with the relative inexperience of the sampling volunteers in conducting vegetation surveys. Since this information is ultimately used to assess aquatic vegetation growth throughout the state and to help implement control techniques on specific lakes, a standardized sampling protocol had to be developed similar to the water quality component of the program. The new protocol would also have to satisfy existing CSLAP and state quality assurance/quality control requirements, allow comparison of results within and between lakes, and simplify the training process. Due to the difficulty in estimating biomass or obtaining quantitative measures of plant growth, the CSLAP vegetation sampling protocol had to center on qualitative assessments of individual plant genera or species (presence/absence), although some effort is made to assess relative abundance of these plants. The program has been limited primarily to sampling within the open water and near-shore littoral zones of lakes.

SAMPLING PROTOCOL

The CSLAP vegetation sampling protocol was developed in 1987 to collect and identify the most dominant submergent and floating macrophyte species in the open water and littoral zones of lakes. While the impetus for the program has been the great interest in adequate management of excessive aquatic vegetation, CSLAP also attempts to provide a general inventory of aquatic plants, including

endangered species, for protecting beneficial plants and assessing plant diversity throughout the state.

Professional staff visit each participating lake one to three times each summer to provide training in new techniques, retrain volunteers who experience difficulty in mastering the sampling or processing procedures, conduct special studies to address specific local concerns, answer questions, provide interpretive data summaries and address lake association meetings. The primary focus of each vegetation sampling session is to familiarize volunteers with the importance of aquatic vegetation within the larger lake ecosystem and the concept of managing lake resources within the scope of stewardship.

Volunteers collect aquatic plants from locations consisting of three equispaced sites along a transect stretching from a depth equal to the maximum Secchi disk reading to the shoreline, travelling perpendicular toward the shore. The first sampling location chosen by most lake associations is an active boating area, usually a public boat launch site or marina. At the deepest point along this transect, weighted rakes with retrieval lines are dropped approximately five feet from the far-shore side of the boat three times at each site. When dragged across the lake bottom, the rake tines grab plants. Upon retrieval, plants are separated into piles of individual genera and species, where possible, based on differing physiological characteristics. Volunteers assume that any specimens that look different constitute unique genera or species. They are given color prints and line drawings for each of the four major non-native exotic species, along with prints and drawings for other common species commonly mistaken for exotics or nuisance algae, and asked to determine if any of the specimen piles correspond to one of these species. This helps to improve volunteers' understanding of exotic plants and expand efforts to educate the public about plant identification. During the initial training session and each quality control visit conducted by the CSLAP staff, other plants of interest are tentatively identified in the field using botany keys.

After the three collections, each genus/species pile is assigned a numeric designation and relative abundance (as percent of total pool of plant piles), and a well-preserved specimen from each pile is dewatered and placed in a labeled bag. Any floating or emergent plant species (within the open water or littoral zone) not collected with the rake at each collection site are hand-pulled, assigned a letter designation and placed in a labeled bag. Additional field information about the sampling site, including description of water depth, distance from shore, classification of bottom sediment, description of uncollected plants, including algae, epiphytes and large emergents, and an estimate of the overall submersed plant abundance, are recorded on a field sampling form. To maintain consistency, any plants seen outside the immediate collection area can be collected and identified, but are not considered to reside within the collection site and are mapped separately.

The same procedure is completed at two additional sites equidistant between the shoreline and the point overlying the water column with depth equal to the maximum Secchi depth. The three sites constitute a single location; volunteers sample as many locations as possible throughout the lake littoral zone to understand the spatial variability in macrophyte communities. Each site location is well-documented to facilitate continued monitoring of the same site in the future. Volunteers are also encouraged to conduct aquatic vegetation surveys as many times as possible during the ice-free months, to gauge the length of the growing season and determine the temporal variability in these plant populations.

The plant specimen bags and field sampling forms are packaged with the regular water chemistry samples and sent in styrofoam coolers with ice packs to the New York Department of Health. Although volunteers often identify some of the plant genera and species using the color prints and line drawings, all plant specimens are identified and archived by NYSDEC staff. Results and interpretive summaries are returned to the volunteers. The vegetation data is also included in the CSLAP Annual Report and is used extensively in the data analyses and development of management recommendations in the five-

year summary report prepared for each participating lake association.

RESULTS AND CONCLUSIONS

There are several important lessons to be learned from the last several years of vegetation sampling. Although quantitative sampling may presently be beyond the scope of most lay monitoring programs, it appears that qualitative plant sampling and collection can be an important part of any volunteer program, and may ultimately serve to greatly increase the pool of information about aquatic plant growth in a lake, region or state. In 1990 and 1991, volunteer teams at 61 lakes collected and sent for identification 532 plant samples, constituting at least 130 unique plant species or genera (about 65 percent submerged), including an identification of each of the four exotic submersed plant species found in New York state. Overall, the 130 unique species come from 30 different families.

The number of statewide verified identifications of *Myriophyllum spicatum*, the most common of the exotic species, increased dramatically due to CSLAP volunteers (nearly 30 percent). While the other exotic plant species were not commonly found in CSLAP lakes, previous vegetation surveys show this may be due to a narrower range and less frequent occurrence of these plants in New York lakes.

The data was also useful in supplementing and updating NYSDEC location maps for various plant species, and for increasing the known range of both native and exotic plants. For most of the CSLAP lakes, this constitutes the only known vegetation identification and has already served to modify planned or proposed management plans. Although significant staff time may be devoted to plant identification, the cost savings associated with volunteer efforts make this portion of a lay monitoring program very attractive, particularly for states committing substantial resources to aquatic plant control. Ultimately, it may be possible to train volunteers to provide more complete plant identification, although some professional staff time will still be needed for identification of important, endangered or unusual plant species.

In comparing CSLAP vegetation data with the vegetation survey data collected through other state- or university-conducted studies, it appears that volunteers were able to locate and collect most of the important vegetation species. Corroboration with independent (quality control) data was even greater when corrected for differing collection depths, sites and the lack of specific emergent plant collection procedures within the CSLAP protocol. Volunteer data provide a reasonable estimate of macrophyte communities in large lakes, particularly if the sampling sites are representative of the in-lake plant community, and often exceed the present pool of data on smaller lakes. This indicates that volunteer monitoring can be used as a surrogate for at least some vegetation work frequently conducted by the scientific community. Together with the water chemistry data, user surveys and watershed analyses presently conducted by volunteers, the vegetation data completes a more rounded body of information than is otherwise available to these lake communities.

It also became clear to staff at the state agencies that the knowledge gained by the volunteers and local communities through participation in this program improved their ability to better manage their lakes. Lake management techniques once proposed and debated at lake association meetings were shelved for more plant-specific techniques that better incorporated ecosystem sensitivity and encompassed the management needs of the lake community.

The aquatic vegetation component of CSLAP did not escape difficulties and problems, however. The method for sample collection and transport was relatively ineffective for obtaining species-level identification of several genera. This problem is due in part to the difficulty in identifying unique species-level physiological differences in the field and laboratory, the difficulty in identifying a mature species from the fingerprint of an immature species, and the tendency for specimen degradation during transport.

To aid in laboratory identification, volunteers are encouraged to provide the complete plant structure,

including roots, flowers, leaves and fruits. The difficulties in identifying plants without the regular assistance of botanists (not available on many government lake management staffs) was not paramount, but precluded precise identifications in some cases. Unfortunately, species identification keys are neither easily reproduced nor understood by the layperson. Since species-level identification of some specimens is often a formidable task for trained botanists, dramatic improvements in species separation and identification may not be forthcoming. The Educational Video Series from the Center for Aquatic Plants at the University of Florida may help volunteers identify aquatic vegetation in the field.

As for specimen transport, additional preservation methods can be employed to reduce degradation. The New Hampshire Lakes Lay Monitoring Program uses glycerol within the plant bags to aid in sample preservation during transport. Samples also can be transported in suspensions or preserved on-site using blotter presses. This, however, can greatly increase the costs associated with vegetation surveys.

It is also very difficult to detect the growth patterns of those plant species that are active under the ice. The potential danger in having unsupervised volunteers sampling on thin ice is too significant to collect this additional information. Since ice can remain from December through April, this eliminates a potentially large portion of the growing season for some particularly hearty plants. The lack of specific techniques for sampling large algae and emergent vegetation, especially those plants growing between the third (shallowest) site and the shoreline, impairs the ability to develop a truly comprehensive inventory of aquatic plants.

Finally, although multiple location sampling is strongly encouraged, some volunteers limit their sampling and time commitment to the aforementioned hot spots. Without a large number of location pockets, vegetation mapping using the sampling results is not very useful. This is perhaps inherent in the use of perpendicular versus parallel (to the shore) transects.

However, in summary, even after adjusting expectations for the limitations associated with these qualitative analyses, it appears clear that a vegetation sampling component of a lay monitoring program can yield important information about ecosystems, and can provide a critical supplement to the existing data already collected by the volunteers.

REFERENCES

Adirondack Lake Survey Corporation. 1984-1987. Adirondack Lakes Survey Reports. Volumes 1-18. Ray Brook, New York.

Eichler, L.W. 1990. Assessment of Brant Lake. RPI Fresh Water Institute at Lake George. FWI Report #90-17.

Ely, E. 1991. Aquatic plants: Value is in the Eye of the Beholder. The Volunteer Monitor. 3(1). p.12.

Kishbaugh, S.A. New York Citizens Statewide Lake Assessment Program: user survey. unpublished results. 1992.

Rensselaer Polytechnic Institute Fresh Water Institute. 1985. An assessment of the water quality of Babcock Lake, Rensselaer County, New York. FWI Report #85-2.

WETLAND MONITORING TECHNIQUES

Presenters: Christopher Swarth, Jug Bay Wetlands Sanctuary; and Amanda Lindley Stone, Audubon Society of New Hampshire.

Christopher Swarth

Jug Bay Wetlands Sanctuary

VOLUNTEERS PLAY IMPORTANT ROLE IN WETLANDS MONITORING

Few habitats in this country have experienced as much loss and degradation as wetlands. Between 30 percent and 50 percent of the original wetlands in the lower 48 states have been lost due to human activity. By some estimates we are still losing up to half a million acres per year. Wetlands, many people once believed, were an impediment to progress; areas to be reclaimed, filled in, or otherwise disposed of because they produced disease, pests and noxious odors. Diking, draining and filling went on at a furious rate. Only in the last few years has society begun to realize the value and importance of these fragile and maligned areas.

Wetlands protection has been nonexistent or slow for several other reasons. Wetlands are transitional lands with blurred boundaries occupying a zone between terrestrial and aquatic ecosystems. Because wetlands change gradually from upland to aquatic conditions, a strict definition tends to be arbitrary. Furthermore, wetlands vary greatly in size, location and hydrological conditions. Only until very recently have the federal agencies responsible for protecting and regulating these areas agreed on a common definition of a wetland. In 1989 the EPA and Army Corps of Engineers agreed to the following definition:

"Wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

Today experts skilled in wetlands delineation use three criteria to identify, measure and map a wetland: hydrology, soil characteristics, and vegetation. The *Wetlands Identification and Delineation Manual*, prepared by the EPA, is used for guidance, jurisdictional determinations and standard field methodology.

As wetlands are protected, we are learning more about the important role they play in the ecosystem and the many benefits they provide society. Wetlands are considered to be among the most productive habitats on the planet, in terms of the weight of plants and animals (biomass) they support. Dead marsh vegetation serves as a primary source of energy to detrital-based riverine and estuarine food webs. A large percentage of commercially important finfish and shellfish depend on this source of detrital material during phases of their life cycle. Wetlands also act as a nursery for fish, provide nesting and non-nesting habitat for large numbers and many species of birds, and support numerous types of reptiles and mammals.

Wetlands provide a number of important values for human society, too. They have been described as kidneys because of their ability to transform and ameliorate the ecological effect of excess nutrients from human wastes, agricultural runoff and acid rain. This function is especially important along coastal rivers, which often have high nutrient levels. Wetlands do such a good job of taking up nutrients

that an increasing number of man-made wetlands are being created specifically for cleansing polluted water. Wetlands help reduce erosion and check the effects of flooding by absorbing and holding floodwaters. They may also aid in recharging groundwater aquifers.

Finally, wetlands are beautiful and mysterious - wonderful places to explore and enjoy.

THE ROLE OF THE VOLUNTEER MONITOR

Citizen volunteers can play an important role in protecting and monitoring wetlands. Education is an extremely important tool, and monitoring is a great way to spread the word. Make your neighbors and elected officials aware of the wetlands in their area! A volunteer wetland monitoring group can enlighten the local community about the value of wetlands while generating data that can be used by resource agencies to enforce laws and stop potential threats.

Here are some components of a wetland monitoring program:

- Sediment Study: Excess sediments from upstream construction or field erosion can adversely affect wetlands. It may be possible to trace sediment sources to their origin. Many states now have laws requiring developers to control silt runoff into rivers and wetlands from construction sites. Farmers can be encouraged to use best management practices (BMPs) to hold soil on their land.
- Permit Check: Most wetlands fill projects require a permit from the U.S. Army Corps of Engineers. This permit spells out details of the project, steps to reduce environmental degradation, size of the fill and other details. A copy of a permit to check for compliance can often be obtained.
- Water Quality Testing: Nutrient pollution can cause algae blooms, which lead to ecological imbalance in a wetland. Volunteers can do onsite analysis for dissolved oxygen levels and turbidity (cloudiness of the water), and can collect suspect water to be tested later at a lab for nutrient levels or coliform bacteria.
- Animal Studies: Subtle, long-term degradation may result in declines in animal populations. Full-scale destruction may leave migrant birds without a critical staging area and resident animals will lose their home. Many wetlands support a high diversity of animals. Because a healthy population is dependent on a well-functioning wetland, it is important to know if the population is remaining generally stable. Birds are highly visible and conspicuous, making them especially easy to monitor. All that may be needed is a pair of binoculars or a spotting scope. There are many conservation groups, such as the National Audubon Society or local birding clubs, that can offer help and advice on formulating methods or may even join in the monitoring effort. Monitoring mammals, reptiles and fish requires more specialized techniques; ask for help from specialists at a nearby college biology department.
- Plant Studies: An advantage of monitoring plants is that they remain in one place. The plant community can provide a lot of information about the health of a wetland. Relatively rapid changes in plant species composition is often related to anthropogenic changes. A variety of simple techniques, such as line transects or permanent plots, can be used to measure changes in a plant community over time. Concentration on a single rare or endangered species or on the spread of a noxious species can be very helpful.

WETLANDS MONITORING AT JUG BAY

One of the goals of the Jug Bay Wetlands Sanctuary in Maryland is to gather data on environmental conditions and train volunteers in ecological field techniques. The wetland monitoring program at Jug Bay consists of long-term studies designed to answer basic questions about the health of a tidal freshwater marsh and characterize the populations of native plants and animals. The studies take place entirely within the 490-acre sanctuary and employ standardized, simple methods or techniques so that citizen

volunteers can be trained fairly easily. Special training sessions are offered as well as on-the-job training. Methods are modified when necessary. This research program was started in 1987, and in 1991 about 100 volunteers assisted with several studies, from water quality/nutrient dynamics to reptile/amphibian populations.

The frequency of data collection varies widely among studies. Some studies occur year-round while others take place only during the breeding or growing seasons. The data are stored on computer spreadsheets and then summarized in technical reports that are made available to the public and to state and federal resource agencies. Information is shared with volunteers through a quarterly newsletter and through slide presentations.

Jug Bay was designated as a component of the Chesapeake Bay National Estuarine Research Reserve in 1990. This has made it possible to expand the research/monitoring program and to improve the system of training and recruiting volunteers. The sanctuary is also better able to disseminate the results of its studies and educate the public about wetlands and the value of citizen monitoring.

Amanda Lindley Stone

Audubon Society of New Hampshire

WETLAND EVALUATION - A TOOL FOR VOLUNTEER MONITORING

Wetlands are among the most fertile, productive and threatened ecosystems in the world, and comprise an estimated six percent of the earth's total land surface. In the past, wetlands were considered insect-ridden wastelands whose best use could only be attained through filling and draining for agricultural, commercial, industrial and residential development. Largely as a result of this view, more than half of America's wetlands have been irretrievably lost. It has only been in recent decades that wetlands have been recognized as valuable natural resources.

WHY EVALUATE WETLANDS?

Wetlands perform a variety of functions which contribute to a balanced and healthy environment, and are valuable to both society and the natural ecosystem in which they exist. It is important to understand these values to help protect and manage one of our most precious and fragile natural resources.

Wetland evaluation is the process of determining the value of a wetland based on an assessment of the potential and/or actual functional values that it performs. Functional values represent the practical, measurable values of wetlands, such as flood control, water quality improvement and wildlife habitat. However, while the overall significance of wetlands is recognized, the functions and values of specific wetland sites often remain undefined. Wetland evaluation can provide a very useful tool for achieving a better understanding of the functions performed by wetlands, collecting valuable baseline information about particular sites, and assisting local and regional planning processes.

HOW DO YOU EVALUATE A WETLAND?

In order to collect information about a particular wetland, one needs to conduct an inventory of the resources available in that wetland. This task is most efficiently accomplished by following an established procedure. Wetland evaluation methods provide a very useful tool for collecting data in a standardized and consistent manner. There are a number of wetland evaluation methods available, primarily for use at the professional level. However, the remainder of this paper describes a wetland evaluation method that was developed in New Hampshire specifically for use by volunteer monitoring groups.

THE NEW HAMPSHIRE METHOD OF WETLAND EVALUATION

The numerous pressures on wetland resources and the nature of wetland protection laws do not always allow the luxury of a detailed scientific study of each threatened wetland resource. However, an established database of the relative ecological values for the wetlands in a defined study area (such as a

town or a watershed) can help local officials make knowledgeable decisions concerning their wetland resources. To this end, the Audubon Society of New Hampshire (ASNH) spearheaded the development of the *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire* (known as the N.H. Method) (Ammann and Lindley Stone, 1991). The production of the N.H. Method manual was a cooperative endeavor between ASNH, the USDA Soil Conservation Service (SCS), and the New Hampshire Department of Environmental Services, Wetlands Bureau. The N.H. Method was based on the *Method for the Evaluation of Inland Wetlands in Connecticut* (Ammann et. al 1986; Levere 1991).

The N.H. Method is a wetland evaluation method that provides local towns with a practical means for determining a wetland's functional values in relation to the functional values of all the wetlands within a defined study area, such as a town, watershed or regional area. This allows the town to inventory and screen wetlands in advance of any proposed activity, and to identify those for which additional protection is warranted.

The N.H. Method was specifically designed to provide a wetland evaluation method that is simple enough for use by public officials and others who have some familiarity with wetlands (but are not necessarily wetlands professionals), while still producing results that are scientifically defensible. After introductory training and professional guidance, groups of volunteer citizens will be able to use the N.H. Method to evaluate wetland resources in their towns. The N.H. Method is documented in a user's manual that leads the user through the evaluation procedure step by step.

WHAT DOES THE N.H. METHOD DO?

The N.H. Method is designed to be used for the comparison of the functional values of a number of wetlands within a designated study area, such as a town or a watershed. It is not suitable for detailed impact analysis or specific detailed evaluation of individual wetlands. The N.H. Method is intended to be applied on a town-wide (or watershed) basis to provide baseline data on the relative values of wetlands for up to 14 separate functional values. The functional values of wetlands evaluated by the N.H. Method include: ecological integrity; wildlife habitat; finfish habitat; educational potential; visual/aesthetic quality; water-based recreation; flood control potential; groundwater use potential; sediment trapping; nutrient attenuation; shoreline anchoring and dissipation of erosive forces; urban quality of life; historical site potential; and noteworthiness.

Each of the functional values listed above is evaluated by answering a series of predictor questions, which are based on the physical characteristics of wetlands. These questions are answered using published data (aerial photographs, soils, topographic and wetlands inventory maps) as well as on-site field investigation. The answers to these questions provide information relating to the ecological functions that wetlands perform.

Central to the N.H. Method is the use of wetland base maps. These maps are initially derived from published sources of information, and are then modified following on-site field checking. Some of the principal resources used in the preparation of these maps include: U.S. Geological Survey topographic maps, national wetlands inventory maps produced by the U.S. Fish & Wildlife Service, USDA Soil Conservation Service county soil survey maps, and large-scale black and white aerial photographs that are available in most county offices.

These resources provide valuable information regarding the location, approximate size and shape of the wetland, the dominant soil characteristics, the roads and buildings located in the vicinity of the wetland, land use in the surrounding areas, and topography. The information recorded in these maps provide a central source for answering predictor questions.

Each of the functional values is evaluated using the information derived from base maps and field investigation, and assigned a unitless numerical score. The scores for each functional value in a particular wetland are then compared with the scores for other wetlands within the study area to determine the relative value of the wetland of interest for a specific functional value. No single overall score is provided.

Following the comparison of functional value scores, all the wetlands in the study area are ranked according their overall significance to the town. The ranking of wetlands for different functional values allows a town to tailor wetland protection for those values it views as most important.

HOW CAN THE N.H. METHOD BE USED BY VOLUNTEER GROUPS?

The N.H. Method is intended to be used by volunteer groups in local towns for the purposes of wetlands inventory and as a land-use planning tool. Furthermore, the N.H. Method provides an important educational tool to further the understanding and protection of wetlands. The N.H. Method manual is designed to provide sufficient background information and a step-by-step procedure to stand on its own as a user's manual. However, it is recommended that volunteer groups undergo introductory training to acquaint them with the use and practical applications of the N.H. Method.

In New Hampshire, with its Yankee tradition of town government, land-use decisions are primarily seen as local decisions. Local conservation commissions (which are comprised of volunteers) have significant input into the state process which issues permits for wetland impacts. The N.H. Method allows towns to base their comments on a scientifically based evaluation system, and can highlight specific critical values of wetlands that may be threatened by some form of impact (residential, commercial or industrial development or road construction). Since its publication in 1990, the N.H. Method has been used by a number of volunteer groups (primarily local conservation commissions) in New Hampshire towns. Most of these local groups have attended introductory training sessions in the use and practical application of the N.H. Method.

While this evaluation methodology was developed for use in New Hampshire, it can be very easily adapted for use by volunteer groups in other states. Currently, Oregon is adapting the methodology for use in their region, and the state of Maryland is considering adapting the N.H. Method for local use.

HOW CAN THIS WETLANDS DATA BE USED?

The data collected can be used for basic inventory purposes, for comparing the functional values of wetlands within a given study area, and for supporting the planning and decision-making process within a town or region. Once a database of relative wetland values has been established for a particular study area, the information is available for local officials to rapidly review the local value of a particular wetland in the context of all the wetlands within that town or watershed. The availability of this information also provides valuable baseline data for the acquisition of wetlands.

REFERENCES

Ammann, A. P., R.W. Franzen, and J.L. Johnson, 1986: Method for the Evaluation of Inland Wetlands in Connecticut. Published by the Connecticut Department of Environmental Protection, DEP Bulletin No. 9.

Amman, A.P. and A.J. Lindley Stone, 1991: Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire. Published by the New Hampshire Department of Environmental Services. NHDES-WRD-1991-3.

Levere, A. (editor), 1991: Method for the Evaluation of Inland Wetlands in Connecticut. Revision of Ammann et.al (1986). Connecticut Department of Environmental Protection, DEP Bulletin No. 9.

ESTUARY MONITORING TECHNIQUES

*Presenters: Kathy Ellett, Alliance for the Chesapeake Bay; Virginia Lee, University of Rhode Island; Sharon Meeker and Ann Reid, University of New Hampshire.**

Kathy Ellett

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USING VOLUNTEERS FOR ESTUARY MONITORING

The following general description of estuarine systems is taken from White, C.P., *Chesapeake Bay: A Field Guide.*

> "An estuary is a semi-enclosed coastal body of water that has a measurable salinity gradient from its freshwater drainage to its ocean entrance. Most estuaries are characterized by daily tides, seasonally variable flow and salinity, and a two-layer circulation pattern; a salty deepwater layer that flows landward and a fresher surface layer travelling seaward that produces a net flow downstream. Typically, mixing is promoted between the two layers by the action of wind, friction, and tides. These are minimum criteria. More than 850 such basins are found in the United States.
>
> Healthy estuaries usually have an open aperture to the sea. Tidal flushing is therefore more vigorous, and this promotes circulation of oxygen and nutrients within the brackish basin. A model estuary must also receive an influx of fresh water from one or several rivers, instead of simple rainwater runoff or contributions from intermittent streams. These rivers provide another source of detritus, dissolved gases, and nutrients, as well as an input of minerals, each important to plant growth and the dual food chain intrinsic to estuaries. Also, high river flow drives estuarine circulation—yielding a net discharge towards the ocean. Some coastal lagoons lack either strong freshwater inflow or a wide ocean entrance and, therefore, are saltier, less productive, and more prone to over enrichment.
>
> The tidal cycle, circulation dynamics, and influx of fresh water provide for a relatively stressful environment for the living resources that inhabit or visit estuaries. Fluctuations in temperature and salinity are only two of the many reasons for this lack of hospitality. Estuaries are typically characterized by a highly variable set of physical and chemical parameters.
>
> The same things that make an estuary a stressful environment to its inhabitants and visitors also make it difficult to monitor. It is not easy to distinguish between changes caused by nature and those caused by human activities. There is no constant flow-through of water as in a river or stream; the hydrology is typically very complex; the presence of salt in varying amounts interferes with many standard procedures for measuring things like dissolved oxygen and nutrients; and there are, as yet, no identified biological indicators as there are for streams and rivers."

Monitoring of estuarine waters is a relatively new activity. All estuaries are downstream from everyone else and have adapted to handle the runoff from one or more watersheds. As people have migrated to the coasts, the estuaries have been overwhelmed and are no longer able to process the nation's pollutants. Because these waters are brackish to downright salty, they have not been used for drinking water and consequently have not had water quality standards imposed for them. Freshwater standards do not fit estuarine waters; one would expect to see anoxia (0

**Transcript Unavailable*

mg/l of dissolved oxygen) in a salt marsh, for instance. The concept of riparian rights has not been applied to the coasts in the same way it has to the banks of rivers. The area between mean high and mean low water has traditionally been in the public domain.

DEFINITION OF MONITORING

The Chesapeake Bay Citizens Monitoring Program (CBCMP) planners defined citizen monitoring as the scheduled sampling of selected environmental and biological variables by volunteers. Citizen monitoring was divided into two categories: formal technical monitoring and non-technical monitoring.

Formal technical monitoring is performed for scientific, technical or legal purposes. For such monitoring: 1) the quality of all data must be assured; 2) the data must have identified value; 3) the data must meet all criteria for inclusion in the Chesapeake Bay database or banks of equal quality; and 4) the potential must exist for continuity over ten or more years.

Non-technical monitoring includes all other types of citizen monitoring. Data from such sampling will vary in content, precision, schedule and duration. Such monitoring can serve many values. These include: 1) education of students and the public; 2) achievement of personal involvement in environmental cleanup efforts; 3) development of preliminary information and useful signals for citizen groups, local and county governmental use, and for other governmental, regional or institutional use. The developed technical monitoring programs can assist non-technical monitoring programs by identifying appropriate and standardized techniques, by effectively communicating related information, and by participating in the development of these widespread citizen efforts to monitor parts of the ecosystem.

PLANNING

The first step in planning a successful volunteer monitoring project is to answer the question, Why do you want to monitor? You should have an identified question or hypothesis in mind before you design your project. Volunteers can help researchers, managers and policy makers by providing:

1. Characterization and assessment of a water body that is not being monitored, particularly when samples or observations are needed from remote locations or from private property.
2. More frequent sampling and time-variable sampling of storms and algae blooms.
3. Observations on number and size of fish kills, amount of precipitation or areas of severe erosion.
4. Maintenance of continuous monitoring equipment.
5. Sample collection and/or delivery for laboratory analysis.
6. Ground truthing for remote sensing.

Projects using volunteers to monitor estuarine waters began in 1985 with the Rhode Island Salt Pond Watchers and the Chesapeake Bay Citizen Monitoring Program. Techniques and methods to measure various physical and chemical constituents were developed and have been adopted and adapted by estuarine programs all around the country.

PARAMETERS MEASURED

Dissolved Oxygen

Most living organisms require oxygen for their basic metabolic processes. Plants, through photosynthesis, produce more oxygen than they use and the excess is released to the water or atmosphere. Oxygen is also dissolved in water through diffusion and surface turbulence. Oxygen is poorly soluble in water, roughly 10 ppm (parts per million) at 0-2 degrees C compared to almost 1,700 ppm for carbon dioxide at the same temperature. When oxygen levels in the water fall below about three to five ppm, fish and many marine organisms cannot survive. Oxygen levels may be reduced because the water is too warm (near a power plant), because there are too many bacteria or aquatic animals in the area, or through overfertilization of water plants by runoff from farmland or addition of sewage which contains phosphates and nitrates.

In general, oxygen levels during mid-day at the surface are near saturation (the maximum level sustained at the temperature), and fall off with depth. Dissolved oxygen levels are an indicator of water quality. Bodies of water which have low amounts of dissolved oxygen also have poor balance between the animals and plants. Eutrophication is the term describing the condition in which high nutrient levels cause an excess of phytoplankton.

The Chesapeake Bay Citizen Monitoring Program (CBCMP) and the Rhode Island Salt Pond Watchers (RISPW) use a Winkler titration kit from LaMotte Company to measure dissolved oxygen.

pH

pH is a measure of how acidic or basic (alkaline) a solution is. In any given solution some atoms of water dissociate to form H and OH ions (H O=H +OH). The pH scale is a means of showing which ion has the greater concentration. At a pH of 7.0 the concentration of both hydrogen ions and hydroxyl ions is equal and the water is said to be neutral. Pure water has a pH of 7.0. When the pH is less than 7.0, there are more hydrogen ions than hydroxyl ions and the water is said to be acidic. When the pH is greater than 7.0, there are more hydroxyl ions than hydrogen ions and the water is said to be basic or alkaline.

pH is defined as the negative logarithm of the hydrogen ion concentration which means that the concentration of hydrogen ions does not increase or decrease in a linear fashion; That is, a pH of three is not just twice as acidic as a pH of six. Increases are in powers of 10. At pH of five there are 10 times more H than at a pH of six. A change in pH of one whole number is therefore quite a large change.

Water dissolves mineral substances it contacts, picks up aerosols and dust from the air, receives man-made wastes, and supports photosynthetic organisms, all of which affect pH. The buffering capacity of water, or its ability to resist pH change, is critical to aquatic life, as it determines the range of pH. Generally, the ability of aquatic organisms to complete a life cycle greatly diminishes as pH becomes 9.0 or 5.0. Coastal marine systems are well buffered. Consequently, pH is not an important indicator. The exception is during intense algal blooms. In an estuarine system where the salinity is highly variable, pH is a useful indicator.

Photosynthesis by aquatic plants removes CO from the water, which can significantly increase pH. Therefore, in waters with plant life (including planktonic algae), especially low-velocity or still waters, an increase in pH can be expected during the growing season. During the 1983 algal bloom in the Potomac River Estuary, a pH of 10 was recorded.

The turbulence of flowing water promotes gaseous interchange between the atmosphere and water. The CO content of water in rivers and streams is less likely to change, but be aware of other events in the watershed that may affect pH. Increased leaching of soils or mineral outcrops during snow melt or heavy precipitation affects pH downstream. Human activities, such as accidental spills, agricultural runoff (pesticides, fertilizers, soil leachates) and sewer overflow may also change pH.

CBCMP uses LaMotte wide and narrow-range color comparators to measure pH at estuarine sites. pH is not measured by volunteers in the Conestoga River, Pennsylvania, project because the river is buffered by limestone underlying the region. RISPW do not measure pH in the ponds where the salinity is higher than 25 parts per thousand.

Temperature

Although temperature may be one of the easiest measurements to perform, it is probably one of the most important parameters to consider. It dramatically affects the rates of chemical and biochemical reaction within the water. Many biological, physical and chemical principles are temperature dependent. Among the most common of these are the solubility of compounds in sea water, distribution and abundance of organisms living in the estuary, rates of chemical reactions, density, inversions and mixing, and current movements. The Chesapeake Bay and lagoon systems, such as the Rhode Island salt ponds, are relatively shallow. This makes their capacity to store heat over time relatively small. As a result, water temperature fluctuates considerably. Water at

higher temperatures holds less dissolved oxygen.

Extreme temperature fluctuations can be stressful to living resources. Increased temperatures raise the metabolic rate of organisms. Aside from the potential stress of temperature changes, certain changes in temperature signal the onset of various stages in the reproductive cycle such as spawning and egg laying.

The temperatures of surface and subsurface water usually differ. This results in thermal stratification of deeper water and can lead to density differences. The Chesapeake Bay's vertical temperature profile is fairly predictable. During the spring and summer months in deeper parts of the bay, the surface waters are warmer than the deeper waters, due to the warmth of the sun. In the fall, the warming radiation of the sun begins to diminish. As the surface water cools, it increases in density, becoming heavier. Once the surface water becomes colder and denser than the water toward the bottom, it begins to sink and vertical mixing occurs. Wind may speed up the process. This mixing action can bring nutrients, materials essential to the growth of organisms, up from the bottom and into higher water levels. This turn-over makes the nutrients available to phytoplankton and other organisms inhabiting the upper water levels. During the winter, the water temperature becomes relatively constant from surface to bottom, until March, when the process of surface warming begins again.

Water Clarity

The transparency of natural waters is directly related to the amount of materials suspended in the water. Particles in the water, such as resuspended sediment or algae, will reduce water clarity. Maximum water clarity is important in maintaining healthy sea grass beds, which are important habitats in shallow coastal and estuarine waters.

The amount of algae in the water is related to the productivity of those waters; usually the greater the nutrient enrichment of a body of water, the more algal growth it is able to support. Sediment, too, is often related to the nutrient enrichment of a river because nutrients such as phosphorus cling to soil particles. Fine sediment can become resuspended in more shallow waters during heavy winds and tidal action. In addition, unprotected shoreline will erode and contribute suspended particles to the water.

The Secchi disk transparency is widely used as a basic measure of water clarity. The Secchi disk is a black and white disk attached in the center to a rope. This rope is measured and marked in centimeters and meters. The weighted disk is lowered slowly into the water and the exact depth just before the disk disappears from view is observed and measured on the marked line. This depth is known as the Secchi disk transparency. The less algae and silt in the water, the greater the water clarity and the deeper the Secchi disk will be visible. Alternatively, turbid water with significant amounts of suspended algae and silt will lower the ability to see the disk resulting in shallow Secchi depth readings.

Salinity

The definition of salinity is the total amount of dissolved solids per 1,000 units of solution. Percent or parts per 100 is shown as o/o whereas salinity parts per 1,000 is shown as o/oo. Typical open-ocean salinities are about 34.8 o/oo. The Rhode Island coastal lagoons salinities range from 25-32 o/oo. Chesapeake Bay salinity off Annapolis in the fall is about 13 o/oo. Salinity in Virginia's James River varies from a mean of 8-19 in the lower estuary to a mean of 0.1 to 0.3 in the tidal freshwaters.

Since seawater enters an estuary through its mouth, the salinity is highest at that point and gradually diminishes as one moves toward the northern end. The salinity levels within the estuary vary, depending on the volume of freshwater that flows into it. Salinity declines in the spring when rainfall, groundwater and melting snow cause large increases in freshwater inflows.

Graduated salinity levels effect the distribution and well-being of the various biological populations living in an estuary. Bottom dwelling species are tolerant of salinity variations but salinity will affect growth and spawning. Some species spawn in freshwater and live mostly in salt water; others do the opposite.

CBCMP determines salinity by measuring specific gravity (density) with a hydrometer and converting the

value to salinity. RISPW use a refractometer which is an optical instrument. Another common method for measuring salinity is a conductivity meter.

Nutrients

Some volunteers are involved in nutrient (nitrogen and phosphorus) sampling. The available kits designed to measure nutrients are often unable to measure the observed concentrations found in surface waters. CBCMP and RISPW volunteers collect and preserve samples that are analyzed in a laboratory. The CBCMP Conestoga volunteers use a LaMotte kit to measure nitrate and nitrite where the concentrations of this nutrient run three to 10+ parts per million.

Other pollutants

Analyses for pesticides, toxic metals, petroleum compounds, PCBs and arsenic require sophisticated laboratory equipment and often require specialized sampling procedures. Consequently, these parameters are not usually measured by volunteers except in support of scientific research projects.

Biological indicators - Bacteria

Disease-causing bacteria are a concern in coastal waters for two reasons: 1) potential contamination of shellfish making them unfit for human consumption; and 2) contamination of bathing areas making them unsafe for swimming.

Different monitoring programs use different methods for sampling bacteria. RISPW train volunteers to take samples which are then analyzed at the state Department of Health and the U.S. Food and Drug Administration laboratories which use the multiple tube dilution (MTD) method. This method is necessary for assessing the safety of Rhode Island coastal waters for commercial shellfishing. Another method, the membrane filtration method (MFM), is used by other volunteer programs including Maine's coastal program.

Rapid bioassessment methods such as those used by streams and river monitoring programs have not been developed for estuarine systems. Volunteers are also involved in fish tagging, identifying beds of submerged aquatic vegetation and checking for eel grass disease.

Work Group Recommendations

BUILDING PARTNERSHIPS WITH GOVERNMENT

Moderator: Susan Handley, United States Environmental Protection Agency, Region 10
Recorded by: Ken Cooke, Kentucky Water Watch

Below is a summary of the discussion and contributions by work group members:

OBSTACLES TO VOLUNTEER MONITORING

1. Existence of government misconceptions about quality and nature of volunteer data collection. Government managers often have an image of kids in the creek, not realizing the procedures and potential of volunteer monitoring projects.
2. Even though the US EPA headquarters office may have adequate stocks of materials and information pertaining to volunteer monitoring program management, there is a lack of information, materials and resources in the regional offices of EPA.
3. National funding of volunteer monitoring programs is scattered and inconsistent. Funding under 319, 106, 205j and other programs for volunteer monitoring projects is encouraged and approved in some areas but not in others.
4. There is a lack of standardization of methods and data-collection formats that makes government acceptance difficult.
5. Environmental protection program managers have a fear of citizens and the public. They get nervous when approached by outside groups.
6. Some government organizations may withhold information about issues and pollution problems on particular watersheds. They seem to erect barriers to getting at public records such as complicated Freedom of Information request procedures, screening files (not providing complete copies of some documents) and stretching the proprietary, litigatory and internal communication provisions of the Freedom of Information Act to block access to documents and records.
7. Citizens don't understand legal restrictions placed on the authority of governmental agencies; they expect more than the agency is empowered to deliver.

RECOMMENDATIONS

1. EPA should publish a list of performance standards and protocols for field procedures tiered for different end uses of information. For example, if data collection is just for personal knowledge, one type of testing will do; if for program management decisions, a more advanced level of testing is needed; and if for regulatory or litigatory purposes a higher level of quality assurance would be needed.
2. All participants of volunteer monitoring programs should work to sell the field to other professional groups by getting on conference agendas and publishing in newsletters and trade journals of groups such as ASWIPCA, NALMS, Water Resources Institutes, professional scientific societies and others.
3. EPA should encourage delegated state agencies to involve volunteers in agency decisions and policy-making by providing them with public notices inviting them to participate in National Pollutant Discharge Elimination System hearings, regulation development hearings, tri-annual reviews, study groups,

review of publications and reports.

4. EPA should develop, publish and distribute training documents and background publications on participation strategies for active citizens in various regulatory programs such as water quality standard reviews, 401, 319, 106, and other programs.
5. EPA should develop and maintain a clearinghouse of information for basic water-quality problem-solving and environmental management similar to River Networks's DORIS computerized database. This may involve setting up a similar operation in the national EPA office or by providing funding for DORIS to do it for us.
6. All participants should conduct outreach efforts directed at local and state officials they are working with, inviting individuals to a monitoring visit, stream walk, canoe float or other outings.

SPECIFIC RESOURCES TO BE DEVELOPED

1. Continue the *Volunteer Monitor* newsletter, with distribution to agencies and other organizations.
2. Provide monitors with a national 1-800 telephone number to call that rings at EPAs's Office of Water and includes one or two assistants to take calls and send out relevant information on volunteer monitoring program management.
3. EPA and other agencies should sponsor regional workshops for volunteer monitors similar to the EPA Region 10 workshop held recently. Regional workshops could also be further subdivided by eco-region, then eventually by watershed.
4. Designate and publicize a staff person in each of the 10 EPA regional offices to provide assistance and follow up support to states and other agencies wishing to establish and operate volunteer monitoring projects. Give that individual the time (80 percent) to fulfill the function.
5. Include a new section of the Clean Water Act that establishes a grant pool fund for state and local volunteer monitoring programs similar to the Environmental Education Act.
6. Tailor program offerings and establish a specific component for advanced student monitors to be used in upper level science programs.
7. Continue sponsoring national citizen monitoring conferences, holding the next one on the West Coast or in Washington, D.C. area if possible.

BUILDING PARTNERSHIPS WITH SCHOOLS AND UNIVERSITIES

Moderator: Esperanza Stancioff, University of Maine

Below is a summary of the discussion and contributions by work group members:

1. School/University administration doesn't give value to citizen projects. Some possible solutions include:
   - Publicity — let administrators know the benefits to them;
   - Get them involved early in design and other aspects of program planning;
   - Tenured professors are at less risk, so get them involved;
   - Get their families involved in fun type events (such as open house).
2. Networking and communication obstacles. Too many projects from schools for agencies and groups to handle. Schools have time and other limitations — other curricula to cover, no communication between schools, which makes regional efforts difficult. So many types of schools and programs to choose from that networking is difficult. Some ideas for solutions include:
   - Hire new people;
   - Train teachers, volunteers and students to train others;
   - Law requires inclusion of environmental education in curriculum;
   - Utilize existing association/directories for networking.
3. Schools and universities face budget constraints which often mean they lack equipment, computers and other supplies. Some ideas for solutions include:
   - Ask for time commitment, lab use, in-kind contribution;
   - Establish partnerships with business or community groups — get corporate sponsor for schools;
   - Run fund raisers for environmental projects.
4. Issue of liability. Some solutions include:
   - Waivers — must be specific;
   - May need liability insurance to get certain grants — team up with organization that has liability insurance, such as Cooperative Extension;
   - Develop clear safety instructions — be repetitive.
5. License/permits to do invertebrate sampling. Solutions include:
   - Work towards change in regulations;
   - Have kids write letters and talk to government legislators;
   - Work together with volunteer groups for change;
   - Contact government agencies to work on change in permit procedures.
6. Educational goals of schools, teachers or students may conflict with monitoring project goals.
7. Must design appropriate level of education for various levels of students.

BUILDING PARTNERSHIPS WITH ENVIRONMENTAL GROUPS

Moderator: Neal D. Emerald, Trout Unlimited

Below is a summary of the discussion and contributions by work group members:

A number of problems and potential solutions were identified during the group discussion. These problems stemmed primarily from the lack of organized infrastructure at the local, state and national level to deal with volunteer water quality monitoring. Below is a summary of the discussion and contributions by group members:

Problem 1

Turf battles among conservation/environmental groups over monitoring the same sections of a stream and what appropriate corrective measures should be taken.

Solution: The need for a local organization or agency to coordinate and assemble monitoring data and specify sampling methodologies and protocols to produce uniform results.

Problem 2

Lack of cooperation between environmental groups and state agencies. At the state level there appears to be two concerns:

a. A need to set state protocols and quality assurances of water quality monitoring data, so that such data is usable by state agencies.
b. A need to coordinate and assemble monitoring data at the state level.

Solution: Agreements need to be reached over which protocols are used and a system of training and testing should be developed to assure that collected data is accurate. A state-level agency needs to coordinate and assemble data from groups working at the local and state level, and also serve as a pass-through conduit to a federal agency which assembles such information.

Problem 3

Federal agencies have a variety of water-quality monitoring programs that need to be coordinated. Between federal land managers and regulatory agencies, it is easy for volunteers to become confused.

Solution: The Environmental Protection Agency (EPA) and the U.S. Geological Survey working together would be an excellent way to coordinate water quality monitoring data from the various federal agencies.

These problems show a definite need for a system to assemble, coordinate and track water-quality monitoring data at all levels. Such data could be relayed through a system starting at the bottom or local level and then progressing upward through the state, regional and federal agencies. This information could then be utilized by anyone requesting such information.

One major point made was the need to reach beyond traditional venues to reach a larger audience in regards to protecting water quality. This point breaks into two separate areas:

a. Many rural areas lack organized conservation groups. This does not mean, however, that residents do not have environmental concerns. An effort needs to be made to reach these people.
b. The environmental community needs to focus attention on utilizing the academic/education community. Groups such as the National Education Association have large yearly meetings. We need to get on the agenda to speak at these meetings about monitoring. We need to educate teachers about environmental concerns.

It was agreed that EPA should continue to hold water-quality monitoring conferences. The group agreed that there is a need for a series of regional conferences which would be held around the country, allowing more people to participate. These regional conferences would be technical in nature.

It was also agreed that a yearly national conference should still be held to bring everyone together to communicate and assess progress in water quality monitoring.

STEERING COMMITTEE

The following persons dedicated time and effort to ensure that the Third National Citizens' Volunteer Water Monitoring Conference was a success. Committee members developed the scope of the conference, created workshop ideas, suggested speakers, helped with logistics and provided a wide range of expertise, background and philosophy to ensure that the conference was a truly cooperative effort, thus reflecting the theme, Building Partnerships in the Year of Clean Water. Without their help, this conference would not have been possible. Thanks to all those who contributed.

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