HOW STATE AGENCIES USE VOLUNTEER DATA

SESSION INFORMATION:

Moderator:

Tina Laidlaw, Volunteer Monitoring Coordinator, USEPA Region 8

Presenters:

Stacey Brown, Virginia Department of Environmental Quality
Cooperation and Partnerships: Virginia's Citizen Monitoring Program, Getting Data to Use

Diane Wilson, Pennsylvania Department of Environmental Protection
Pennsylvania's Citizens' Volunteer Monitoring Program

Esperanza Stancioff, University of Maine Cooperative Extension
The Maine Shore Stewards Program Use of Data

Karen Font Williams, Oregon Department of Environmental Quality
Oregon's Volunteer Monitoring Program

HOW STATE AGENCIES USE VOLUNTEER DATA

Cooperation and Partnerships: Virginia's Citizen Monitoring Program, Getting Data to Use

CONTACT INFORMATION

(corresponding author)
Stacey Thurmond Brown
Virginia Department of Environmental Quality
P.O. Box 10009, Richmond, VA 23240
phone: 804/698-4026 or 800/592-5482 ext 4026
email: stbrown@deq.state.va.us

Jay Gilliam
Virginia Save Our Streams Program
7598 North Lee Highway, Raphine, VA 24472
phone: 540/377-6179
fax: 540/377-6179
email: strmiwla@cfw.com

Jody Johns-Cason
Virginia Department of Conservation and Recreation
203 Governor Street, Suite 206, Richmond, VA 23219
phone: 804/786-9732
email: jjohnscason@dcr.state.va.us

For more information about Virginia's citizen monitoring program please contact one of the above or check the web site www.deq.state.va.us

Cooperative and strong environmental leaders have created the avenues for citizen data use. Their hard work did not materialize into data use by state agencies overnight. Instead, persistent and careful work was needed to convince the state agencies to take note. The trust, cooperation, and partnership that is the foundation of the Virginia Citizen Monitoring Program is embodied in the organization Citizens for Water Quality and several letters of agreement. Both the letters of agreement and the formation of the Citizens for Water Quality have been the catalyst for creating avenues for the state water quality agencies to use citizen collected data. The effectiveness of citizen monitors will continue to increase based on new initiatives such as the development of watershed councils.

Virginia's Monitors

Stewardship of land and rivers is a concept that comes naturally and easily to Virginians. Many groups have formed over the years to provide advocacy for the natural resources of their region. Sometimes these groups have been limited in membership to riparian property owners but often they are diverse organizations with representatives of many stakeholder constituencies.

The Virginia Save Our Streams (VA-SOS) program became a priority project of the Virginia Division of the Izaak Walton League of America (IWLA) in mid 1996. At that time, Jay Gilliam became the state coordinator for the VA-SOS program. During his travels across the state, it became obvious that there were many grassroots groups advocating better water quality. Large groups such as the Friends of the Shenandoah and Friends of the North Fork of the Shenandoah had been doing chemical monitoring for many years. Smaller groups such as the Staunton River Watch came together in reaction to perceived water quality problems in their area. Jay's own experience and that of follow citizen monitors revealed that there were hurdles to collecting and using citizen water quality data. The obstacles that these groups faced were that there was no real guidance on acceptable monitoring methods, design of monitoring networks, quality assurance of data methods, and the management and use of citizen water quality data. VA-SOS, in cooperation with the Department of Conservation and Recreation (DCR) and the Department of Environmental Quality (DEQ), began to organize *Citizen's for Water Quality Summits* to provide a forum for sharing ideas and concerns. In November 1996, the Citizens for Water Quality met for the first time. The outcome of this first meeting was a consensus that there was a need for the Commonwealth of Virginia to create a statewide citizens water quality monitoring coordinator. This request was presented to the Virginia General Assembly and the position was created by budget amendment during the 1997 session. Stacey Brown was hired to work in DEQ's water monitoring division in January 1998.

To further define the roles of the state agencies and citizen groups in promoting citizen monitoring in Virginia, VA-SOS pursued Letters of Agreement with both state agencies. DCR signed a Letter of Agreement with VA-SOS in January 1998. A similar agreement was signed soon after by the DEQ in April 1998. Both Agreements set forth a strategy for mutual cooperation towards common goals for citizen monitoring.

Letters of Agreement

The "work plan" for developing a Citizen Monitoring Program in Virginia was first embodied in these Letters of Agreement. The goal of these Agreements was to enhance the state's ability to protect water quality by supporting

citizen monitoring efforts throughout the Commonwealth. These Agreements outlined specific tasks to obtain that goal and to develop the base for a coordinated citizen monitoring effort in Virginia.

1998 Letters of Agreement

The agreements outline three areas of cooperation in order to further Citizen Monitoring efforts in the Commonwealth:

- citizen monitoring support network,
- quality assurance and quality control, and
- data assessment.

These three items include specific tasks to be accomplished.

Citizen Monitoring Support Network

The tasks included within the citizen monitoring support network encourage collaboration among state agencies and citizen monitors. The sum of these tasks included in this section formed the working organization *Citizens for Water Quality* and established *Stream Schools*. *Citizens for Water Quality* serves as a forum for citizen grassroots organizations to share experiences and knowledge about water quality and diverse issues around the state. The organization has adopted by-laws and meets at least three times a year to facilitate communication. Additionally, members are informed about statewide activities relating to water via *blast e-mails* and a web page, currently hosted by DEQ (www.deq.state.va.us/cmonitor/cwq). One of the highlights of the first year of *Citizens for Water Quality* is a "Declaration for Virginia's Waters" that was signed by over 50 grassroots organizations and delivered to the Secretary of Natural Resources on the steps of the Capitol.

Some citizen monitoring organizations experience frustration trying to decipher the roles and responsibilities of federal and state water quality agencies. Citizens must rely on the knowledge and/or experience of fellow monitors, page through information on the Internet, or tackle the telephones in search of answers to their water quality questions. *Stream Schools* are an attempt to present the roles and responsibilities of federal and state water quality agencies. Additionally, the schools provide information on monitoring techniques (professional and volunteer methods). In 1998 and 1999, the stream school curriculum was successfully piloted on three groups of DCR and Natural Resource Conservation Service (NRCS) employees. (To date, two public stream schools have been presented in accord with the 1999 Letter of Agreement.)

Quality Assurance and Quality Control

The tasks included within the Quality Assurance and Quality Control (QA/QC) section include tasks to make citizen monitoring data more *usable* to water quality agencies. The items in this section include the development of a statewide citizen water quality monitoring methods manual and the establishment of a coordinated quality assurance and quality control review.

The Virginia Citizen Monitoring Methods Manual is unique. It offers a variety of methodologies for measuring the same parameters. Virginia has had active citizen monitoring groups for many years. Because these groups worked in a vacuum, they adopted different methodologies. Rather than throwing away the good work done by these citizen organizations, the methods manual seeks to be inclusive of citizen monitoring methods throughout the Commonwealth. The manual is a living document, with new methodologies being added as necessary. The manual can be downloaded at www.deq.state.va.us/cmonitor and a hardcopy is available by request (contact VA-SOS at 540-377-6179).

The beginnings of the quality assurance quality control project plan review process were developed in the 1998 Letters of Agreement. This item is continued in the 1999 Letter of Agreement. DCR and DEQ agreed to accept either agency's review of a QA/QC plan and both agencies will accept a plan approved by the Environmental Protection Agency (EPA). The streamlined EPA Volunteer QA/QC plan was deemed acceptable by both agencies for the purpose of citizen monitoring organizations.

Data Assessment

One of the biggest boosts for citizen monitoring is creating avenues for data use at the state level. The most notable items completed in this section of the Letters of Agreement are the development of a data use matrix and identification of the appropriate agency response to pollution events discovered by citizen monitoring data.

The data use matrix developed as a result of the 1998 Letter of Agreement was modeled after several state's defined uses of citizen data. The matrix includes four uses of citizen generated data. A companion document was developed to further define these uses. This document, QA/QC Tiers, identifies different levels of quality assurance for citizen organizations. These two documents have recently been simplified into a Statement of Citizen Data Use, outlining four uses of citizen data by the state water quality agencies.

Although DEQ has always had a pollution response policy, citizen monitors felt left out of the equation. There was no mechanism for a citizen monitor to report a data collection event that fell outside the norm for any particular site. The 1998 Letter of Agreement addressed this issue and determined that potential pollution events identified by citizen monitoring data would warrant a site visit by DEQ field staff.

1999 Letter of Agreement

The 1998 Letters of Agreement were very successful. Most of the tasks outlined in the 1998 agreements were accomplished. More importantly, a solid foundation for citizen monitoring activities was developed and coordinated by three partners: VA-SOS, DCR, and DEQ. To continue the success of citizen monitoring in Virginia, and further solidify this new partnership, a three-way Letter of Agreement was signed in October of 1999.

This new agreement has the same three components as the 1998 Agreements: citizen monitoring support network, quality assurance and quality control, and data assessment. Some of the highlights to be accomplished under Citizen Monitoring Support include:

- develop a funding guide for citizen monitoring activities,
- host a grant-writing workshop for citizen monitors,
- administer the Citizen Monitoring Grant established by the Virginia General Assembly, and
- administer at least four stream schools (by basin) across the state. (An Upper James Watershed and Shenandoah Watershed Stream School have recently been completed.)

Items identified under quality assurance and quality control include:

- develop appropriate biomonitoring methods for eastern Virginia,
- continue to update the Virginia Citizen Monitors Methods Manual,
- provide QA/QC training for citizen monitors, and
- develop an audit for citizen QA/QC plans.

Data Assessment items include:

- revising the data use matrix,
- convening meetings with DEQ and DCR data users to discuss future data applications, and
- providing citizen monitoring data on-line.

An additional element of the 1999 Letter of Agreement is to develop benchmarks for evaluating the success of the Letter of Agreement and citizen monitoring throughout Virginia.

Data Use

Although the state was always committed to using citizen data, identifying those uses and receiving the endorsement of our “professional” monitors did not happen overnight. Several things needed to be in place before citizen data would be used by the state agencies. The desires of the agencies’ management needed to buy into the value of citizen collected data. This buy-in was documented via the 1998 Letters of Agreement. While most of the “professional” monitors welcomed citizen collected data, a few were wary of the data. The eagerness of citizen monitors to provide high quality data and to work with the state agencies to fill data gaps convinced all involved that defining avenues for data use is a worthy effort.

While four uses of citizen data have been identified (detailed below), this is a work in progress. As the agencies get more used to using citizen data and the quality of citizen collected data increases, the uses applied to citizen data will change (and increase).

- *Background Information*– Citizen monitoring data can be used to provide background information where no other monitoring data exists. Chemical, biological, and physical data can be used to establish background conditions. The most useful data should be collected under a QA/QC plan, a state approved QA/QC plan is not necessary but is encouraged.

- *Assessment Information*– Citizen monitoring data will be used by state agencies in statewide water quality assessment reports. Citizen monitoring data collected under approved QA/QC project plans will be used by the state agencies in statewide water quality assessment reports (305(b) and Nonpoint Assessment Report). In the biannual 305(b) water quality report, citizen collected data will be evaluated to determine the pollution potential of the monitoring site. Citizen monitoring sites with high pollution potential will be included in the Part IV of the 303(d) list (threatened waters). Future agency monitoring will be directed to those sites included on the 303(d) threatened waters list.

- *Red Flag for Pollution Events*– All data collected that indicates unusual conditions for the site will be referred to the Regional DEQ office for further investigation. A site visit will be made by DEQ personnel (either at the regional level or by the Citizen Monitoring Coordinator). This site visit will be made in a timely manner and written results of the DEQ site visit will be reported back to the citizen monitor as soon as possible.

- *Special Studies*– Citizen monitoring data can be used for a variety of special studies. Those studies that should be developed in cooperation with DEQ and DCR include studies on TMDL identified stream segments and studies to determine the effectiveness of BMPs in a watershed. Methods, parameters, site locations, sampling times, and QA/QC measures will need to be developed on a case by case basis depending upon the needs of the state agencies and abilities of the monitoring group.

Citizen monitors can develop a TMDL special study that provides useful information to the TMDL process. The best information citizen monitors can provide about TMDL listed water segments are physical characteristics of the waterway (information about the physical makeup of the stream channel and habitat characteristics) and current information about surrounding land use.

Monitoring Councils

In 2000, VA-SOS, in cooperation with DCR and DEQ, initiated a new citizen monitoring strategy which focuses on giving monitors the information and tools they need to provide useful data to state agencies and local governments. The development of "monitoring councils" will allow VA-SOS and the agencies to target monitoring efforts in areas with the greatest need for data. Monitoring councils are composed of trained citizen volunteers dedicated to collecting useful environmental information in their watersheds. VASOS, DCR, and DEQ are working collectively to provide water quality monitoring training to interested citizens across the Commonwealth. Citizens are schooled in chemical, biological, and physical monitoring methods.

VASOS, DCR, and DEQ hope to organize as many monitoring councils across Virginia as possible. Citizen interest and agency need will determine where the monitoring councils are formed. When interested citizens have received adequate training and are prepared to organize a monitoring network, VASOS, DCR, and DEQ will first assist the group in determining the scale of the watershed to be monitored. Once the monitoring area has been determined, students at Washington and Lee University, with Geographical Information Systems (GIS) technology, will prepare watershed maps. VASOS, DCR, and DEQ granted funds to Washington and Lee University for the purchase of a GIS plotter. In return, Washington and Lee has agreed to prepare watershed maps for each of the monitoring councils. These maps will exhibit impaired stream segments, nonpoint source pollution potential ranking, DEQ monitoring sites, permitted discharges, location of flow gauges, and land use information.

With the watershed map as a tool, one or more representatives from VASOS, DCR, and DEQ will meet with the monitoring council and work one-on-one with the monitors to design a monitoring plan. A monitoring plan describes the monitoring scheme and outlines the rationale behind it. Specifically, the monitoring council, in consultation with VASOS, DCR, and DEQ will:

- identify data needs and uses

- analyze available manpower
- determine sample location accessibility
- estimate the cost of equipment and sample processing
- identify goals and objectives
- outline parameters to be monitored
- organize a schedule of tasks
- develop a quality assurance quality control project plan.

All of these elements will be embodied in the resultant monitoring plan. Together, DEQ and DCR will define agency data needs. DEQ and DCR will use the Annual Ambient Monitoring Report and the 305(b) and 303(d) water quality assessments to determine where and what type of monitoring, if any, is occurring, and the location of impaired and threatened segments. The agencies will also consider the watershed's nonpoint source ranking as determined by the 1997 Virginia Nonpoint Source Pollution Watershed Assessment Report, watershed assessment priorities outlined in the 1998 Unified Watershed Assessment and Restoration Priorities and project, special studies, and citizen collected data.

In the past, one of the difficulties for citizen monitors has been the coordination of data submission to the state agencies. The lack of local leadership stymies the transmission of citizen monitoring data to the state agencies. Local leaders are needed to help maintain the schedule of tasks and report the data. Monitoring councils may help fill this role within the watershed. Virginia has 46 soil and water conservation districts (SWCDs). In some areas, SWCDs may be able to provide local leadership for the monitoring council. Colleges, businesses, and grass roots organizations may also be effective local leaders.

Monitoring councils will improve coordination between citizen monitors and state agencies and increase the amount of environmental data available to support the development of Total Maximum Daily Loads (TMDLs) and/or Watershed Action Plans. VASOS, DCR, and DEQ have begun to provide training and support in watersheds. Examples are the Maury River Watershed with the Maury River Watershed Group, the Appomattox River Watershed with Clean Virginia Waterways, and the Nottoway River Watershed with the J.R. Horsely Soil and Water Conservation District.

Cooperation and Partnership

VA-SOS, DCR, and DEQ have accomplished many of the goals set forth in the 1998 Letters of Agreement. Collectively, VA-SOS and the agencies continue to set additional goals for the citizens monitoring initiative. This partnership is bearing fruit. State and federal agencies, colleges, private foundations, business groups, local governments, and many soil and water conservation districts are joining the effort. Interested groups meet approximately three times a year as the Virginia *Citizens for Water Quality*. The Citizens for Water Quality are dedicated to proving that interested citizens can work cooperatively with state agencies to magnify their capabilities. The success of Virginia's citizen monitoring program does not lie with one entity. It takes cooperation, partnership, and trust to ensure success in a program with such varied interests. The support of the Secretary of Natural Resources, the Director of the Department of Conservation and Recreation, and the Director of the Department of Environmental Quality have been invaluable. The trust and cooperation between citizen organizations and the state agencies have been elemental to the recent progress of the citizens monitoring initiative. Virginia's program of cooperation and partnership in the citizen monitoring program is becoming a model for other states wishing to obtain the same success.

HOW STATE AGENCIES USE VOLUNTEER DATA

Pennsylvania's Citizens' Volunteer Monitoring Program

CONTACT INFORMATION

Diane Wilson, Citizens' Volunteer Monitoring Program Coordinator
Pennsylvania Department of Environmental Protection
400 Market Street, Harrisburg, PA 17105-8555
phone: 717/787-3730
fax: 717/787-9549
email: wilson.diane@dep.state.pa.us

Introduction

Pennsylvania has a rich history of grassroots volunteer water monitoring. A recent survey by Pennsylvania's Department of Environmental Protection's Citizens' Volunteer Monitoring Program indicates that there are at least 140 groups, comprising 11,000 individuals, who collectively spend more than $1,000,000 on monitoring activities. A number of the community based monitoring groups have gone beyond water quality monitoring to restoration activities. The goals and activities of the Citizens' Volunteer Monitoring Program, which was initiated in 1996, are attuned to the goals and needs of the community based monitoring groups. Some of the actions taken by the Citizens' Volunteer Monitoring Program to meet the needs of local groups include: the formation of a statewide Volunteer Environmental Monitoring Panel, an extensive training program tailored to individual group's goals, and a handbook for community based monitoring. The handbook is unique in that it does not prescribe standardized protocols for all. Instead it advocates the use of a study design process and a choice of monitoring methods appropriate to the goals of the individual group. The program has partnered with the Environmental Alliance for Senior Involvement, the Pennsylvania Department of Aging, and the Pennsylvania Senior Environment Corps on the organization of a stream monitoring program with standardized protocols and a quality assurance project plan for senior citizens. The program has also undertaken an extensive and ongoing study of potential uses of volunteer collected data in state assessments.

Data Use by the Pennsylvania Department of Environmental Protection

In order to see how community based monitoring can be used in state assessments in Pennsylvania, it is important to first clarify how the Department of Environmental Protection collects and uses data. The Department's data collection focuses primarily on monitoring the ecological health of the waters and impacts of toxic pollutants on public health. One of the monitoring activities carried out in assessing the state of the waters is a long-term water quality network of 150 fixed monitoring stations on rivers, streams and lakes throughout the state. These stations are located in major streams, selected reference waters, and selected lakes. Each of the stations is sampled for stream discharge, or lake height, and for a variety of chemical and physical indicators. A biological evaluation using benthic macroinvertebrates is carried out once per year at routine stations and three times per year at reference stations. This water quality network does not cover the majority of Pennsylvania's 84,000 stream miles. Consequently the state has undertaken an Unassessed Water Strategy to evaluate all of these waters with priority given waters where there is potential for non-point source pollution. The Department of Environmental Protection also carries out Aquatic Life Special Water Quality Protection Surveys. The purpose of these surveys is to assess the need for special protection and to revise the state water quality standards if necessary. The Department of Environmental Protection also conducts Cause/Effect Surveys to determine if specific sources of point or non-point source pollution are causing known problems. Use Attainability Studies are carried out, if necessary, to review and revise water quality standards to ensure that designated fish and aquatic life uses are protected. The Department of Environmental Protection also carries out lake assessments and maintains an Ambient and Fixed Station Network Monitoring Program to monitor the general quality of groundwater.

The Role of Community Based Monitoring in State Assessments

Traditional Pathways

Volunteer monitors in Pennsylvania sample daily, monthly, semi- annually, and quarterly at over 3000 sampling stations throughout the state. The information can be used to supplement the 150 stations on the water quality network. It also has been used as a screening tool to raise a red flag to trigger a Cause/Effect Survey or a Use Attainability Study.

Data collected under a written quality assurance/quality control plan that follows strict criteria concerning age of data, identification of a stream segment, and frequency of sampling has been used in the compilation of the Water Quality Assessment 305(b) report and resulting 303(d) list of impaired waters.

The handbook— *Designing Your Monitoring Program, A Technical Handbook for Community-Based Monitoring in Pennsylvania*—has an entire tract dedicated to describing how a monitoring program must be designed and

implemented if the goal is to have data usable in the 305(b) report and 303(d) list if the stream segment is not attaining the applicable water quality standard. The Citizens' Volunteer Monitoring Program, in collaboration with the Department of Environmental Protection's Division of Water Quality Assessment and Standards, solicited outside sources of data to be utilized by the Department in the 303(d) listing process. Watershed associations, community based monitoring groups, and others were sent a letter with detailed guidance on data collection and reporting requirement. Ten groups responded, with five submitting data usable for the year 2000 303(d) listing. A training session will be planned and implemented by the Citizens' Volunteer Monitoring Program in the year 2000 to offer specific guidance to groups who want to collect data for use in the year 2002 305(b) report and 303(d) listing.

Other Pathways

There are pathways that go beyond these more traditional avenues for use of data collected by community based monitoring groups. The Citizens' Volunteer Monitoring Program conducted an extensive review of programs within the Department of Environmental Protection to solicit additional uses for citizen collected data. The list of existing uses includes:

- Macroinvertebrate Monitoring - A group of anglers noticed a sharp decline in the macroinvertebrate population in their trout stream and alerted a regional office of the Department of Environmental Protection. It was determined that the catastrophic decline in the macroinvertebrate population was due to a pesticide spill. The anglers formed a monitoring group and are now assisting a department biologist in collecting and identifying macroinvertebrates to study the recovery of their stream.

- Funding Allocation - Volunteers are being asked to provide water quality data in support of grant applications for state funding of watershed restoration projects.

- Abandoned Mine Land Project - Community based monitoring groups are performing watershed assessments to site remediation projects undertaken by the Department of Environmental Protection in areas impacted by abandoned mine drainage. They also do pre and post project monitoring for the same remediation.

- Pennsylvania Senior Environment Corp - Senior volunteers monitor chemical, physical and biological indicators, along with habitat assessments in over 100 watersheds throughout the state. The data is made available to the Department of Environmental Protection to be used as a screening tool to determine where further study may be needed. They also act as "eyes and ears" for the Department in the watershed.

- Watershed Snapshot - Thousands of volunteers from all over the state of Pennsylvania monitor chemical, physical, and biological indicators during a 10-14 period in April and send their data to the Citizens' Volunteer Monitoring Program for inclusion in an annual report.

The list of potential uses include:

- Riparian buffer monitoring – Volunteers would monitor the effects on stream quality when buffers are restored.

- Wetland monitoring – Volunteers would check wetland losses and function changes (forested to emergent), monitor replacement sites, monitor advanced compensation wetlands, and assess watersheds to locate areas for wetland restoration projects and inclusion in the wetland registry.

- Habitat monitoring – Volunteers would monitor habitat loss including streams, wetlands, and lakes over time.

- Survey stream obstructions – Volunteers would locate obstructions in the watershed including debris blockages, constricted culverts, etc.

- Watershed field views for abandoned mine land projects – Volunteers would do field views of watersheds impacted by abandoned mining, locate seeps, and field test seeps for quality.

- Lake monitoring – Volunteers would do lake trophic studies including physical and chemical profiles.

- Habitat surveys for TMDL remediation – Volunteers would perform follow-up biological and physical habitat surveys on streams targeted for TMDL remediation (qualitative biomonitoring and physical habitat evaluation).

- Stormwater management plan sampling – Volunteers would acquire physical data for stormwater planning in a watershed.

- Monitoring stormwater facilities – Volunteers would monitor the workings of stormwater facilities such as ponds, swales and ditches, and monitor their impacts on local watersheds.

- Zebra mussel monitoring – Volunteers would check streams for zebra mussels and their impacts, check special substrate samplers for zebra mussel infiltration.

- Stream walks – Volunteers would do stream walks to observe local conditions and to observe problems such as malfunctioning on-lot systems. This would also give agencies an idea of land use and impacts along the stream.

- Observe flood protection projects – Volunteer would check flood protection projects to make sure the structures are operational, also check function during and after flood events.

- Winter stonefly monitoring - Volunteers would monitor adult stoneflies in the winter to give an idea of stream quality and will assist in setting up additional monitoring in summer/fall.

- Watershed field views for nonpoint source remediation projects – Volunteers could do watershed surveys to check on the success of nonpoint source restoration/remediation projects, observe stream conditions near the projects, land use and best management practices.

Conclusion

In addition to these existing and potential projects, the Citizens' Volunteer Monitoring Program will be making a special effort to work with groups that get Section 319 (Nonpoint Source Management grant) funding. Volunteers will monitor the impacts of watershed restoration projects completed with the 319 funding. With all the activity in the volunteer monitoring community, there are a large number of monitoring projects that communities and the Department of Environmental Protection could undertake together to protect and enhance water resources across the state.

HOW STATE AGENCIES USE VOLUNTEER DATA

The Maine Shore Stewards Program Use of Data

CONTACT INFORMATION

Esperanza Stancioff, Statewide Water Quality Biologist, Director of the Maine Clean Water Program
University of Maine Cooperative Extension
Knox-Lincoln Counties Office
PO Box 309, 235 Jefferson Street
Waldoboro, ME 04572-0309
phone: 800/244-2104 (in Maine) or 207/832-0343
fax: 207/832-0377
email: esp@umext.maine.edu

Introduction

Since 1988, citizen volunteers have been successfully engaged in environmental monitoring along the Maine coast (the Maine coast is illustrated in Figure 1). It all began with two midcoast groups that decided to investigate the nature of local water pollution problems. These groups started their own local monitoring programs– working in partnership with the University of Maine Cooperative Extension (UMCE) and receiving technical support from the Department of Marine Resources (DMR) and the Department of Environmental Protection (DEP). This take-charge model of environmental stewardship soon expanded statewide as more communities saw that they too could make a difference in preventing or remediating pollution problems in their coastal areas. A primary concern and measurable result of these local efforts has been the reopening of shellfish growing areas.

By the late 1980s, DMR recognized this untapped, person-power resource and began calling on these local volunteers to assist with collecting water samples for analysis at the DMR labs to identify pollution sources and get more acres of shellfish flats open for harvesting. In 1998 and 1999, 43% of all the bacteria samples analyzed were collected by volunteers (Figure 2). Over 100,000 acres of clam-flats have been opened for harvest over the past five years in large part due to the efforts of the volunteers. The Maine Department of Marine Resources surpassed their 2000 goals of opened shellfish area by 1997. The Maine DMR is the only state agency which is a member of the Interstate Shellfish Sanitation Conference that uses volunteers in the collection of data to classify shellfish growing areas.

The Maine Phytoplankton Monitoring Program

In 1996 the University of Maine Cooperative Extension (UMCE), in collaboration with the Maine Department of Marine Resources (DMR) and the US Food and Drug Administration (USFDA), created an innovative volunteer-based phytoplankton monitoring program. The identified need was to enhance the capacity to detect harmful algal blooms (HAB's) that have caused closures of shellfish harvest areas Gulf-wide, due to possible lethal toxicity, which can result in extreme revenue loss to shellfish harvesters. Until this phytoplankton monitoring program was

Figure 1: State of Maine

initiated, HAB monitoring at DMR was based solely on toxicity levels in shellfish. This program augments traditional biotoxin monitoring programs by looking for phytoplankton species in the water column that might be responsible for shellfish toxicity. This novel approach to HAB monitoring is not mandated by law, and has not been supported by governmental funds. This program has empowered citizens through their participation in providing vital information to decision-makers.

Potentially toxigenic species of phytoplankton have been detected in the Gulf of Maine, and are a potential threat to public health and economic resources. HAB's can also present serious issues to aquaculturists. Fish, particularly those reared in pens, are susceptible to oxygen depletion caused by some species of phytoplankton, skin damage and damage to gill tissue (Martin 1997). Scientists now believe that Harmful Algal Blooms (HAB's) are increasing in severity, geographic distribution, and in species being adversely affected.

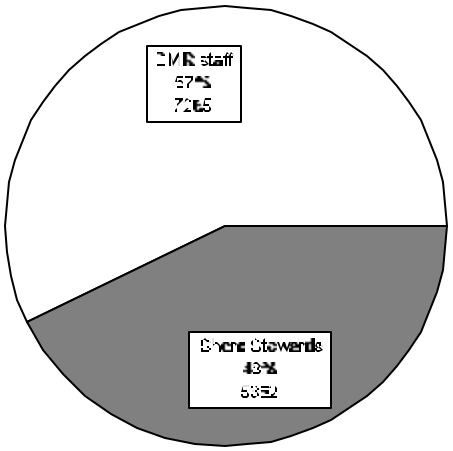

Figure 2: Water Quality Samples: 1999
(Shore Stewards are comprised of DMR volunteers and Clean Water/Partner in Monitoring volunteers)

The major goals of this project, modeled after the USFDA protocol used in other states, are:

- to assist shellfish management agencies with marine biotoxin monitoring efforts by providing early-warning detection of toxic species of phytoplankton

- to determine if a correlation exists between potentially toxigenic phytoplankton in the water and a toxic event in shellfish through the collection of baseline data

To date, the program has 25 monitoring groups covering 40 sampling locations along the coast of Maine with approximately 80 volunteers. Volunteers monitor weekly from April through October, and send data reports directly to the biotoxin team at the Maine Department of Marine Resources where, to date, there are over 1800 data entries on phytoplankton populations from the volunteers.

Volunteer groups have, each year, found *Alexandrium spp*. in the water column days before the shellfish were found to be toxic. This program has also proven to be an important educational tool for schools and citizens while collecting needed scientific data pertaining to phytoplankton and HAB's. Through the success of our program, we have been able to assist with the development of other phytoplankton monitoring efforts in the Gulf of Maine; aiding in the development of a new phytoplankton monitoring program in New Hampshire and providing support to the phytoplankton monitoring program in Massachusetts.

The monitoring groups have collected data on the abundance and distribution of phytoplankton in Maine waters that could potentially affect public health. Over time, these data will help scientists identify trends in abundance and distribution of phytoplankton. The amount of coverage volunteer monitors achieve through weekly sampling could not be replicated by the limited monetary and personnel resources available to the scientific and regulatory community.

Data collected through our program has drawn the attention of research scientists currently working in the Gulf of Maine. In 1998, volunteers observed the presence of large numbers of *Dinophysis spp*. in Maine, a genus known to have species responsible for causing Diarrhetic Shellfish Poisoning (DSP). This prompted researchers to direct efforts to address these findings. The results indicated the presence of another toxic species in Maine, *Prorocentrum lima,* also known to cause DSP. This epiphytic species has a different life history, and we will be developing a protocol to sample for it this year. We are also participating in the ECOHAB project with the Woods Hole Oceanographic Institute (WHOI) by taking coastal quantitative samples. This relationship to the scientific community strengthens the credibility of the program, and empowers citizens by linking them to research in the Gulf of Maine.

HOW STATE AGENCIES USE VOLUNTEER DATA

Oregon's Volunteer Monitoring Program

CONTACT INFORMATION

Karen Font Williams
Oregon Department of Environmental Quality
1712 SW 11th Avenue, Portland, OR 97201
phone: 503/229–5983, fax: 503/229-6924
email: williams.karen@deq.state.or.us

Introduction

The Volunteer Monitoring Program at the Oregon Department of Environmental Quality (DEQ) operates within the Water Quality Monitoring Section of the Laboratory Division in Portland, Oregon. Laboratory staff collect and analyze air, water, soil and biological samples for DEQ offices across the state. The Water Quality Monitoring Section manager oversees several monitoring coordinators, including the Volunteer Monitoring Coordinator.

The Volunteer Monitoring Coordinator is funded by the Oregon Plan, a 1997 initiative to restore and protect native fish populations and the quality of the state's waters. Coho, chinook, and chum salmon as well as steelhead and bull trout have been listed as endangered or threatened under the Endangered Species Act. A successful Oregon Plan depends on the cooperation of citizens, industry, municipalities, state and federal agencies, agriculture, forestry, and environmental groups. Volunteer monitoring fits well into the Oregon Plan as volunteers carry out public education and encourage local participation in watershed issues.

The Oregon Plan website emphasizes the importance of community-based action:

> *Government, alone, cannot conserve and restore salmon across the landscape. The Plan recognizes that actions to conserve and restore salmon must be worked out by communities and land owners, with local knowledge of problems and ownership in solutions. Watershed councils, soil and water conservation districts, and other grassroots efforts are vehicles for getting the work done. Government programs will provide regulatory and technical support to these efforts, but the bulk of the work to conserve and restore watersheds will be done by local people. Education is a fundamental part of community-based action. People must understand the needs of salmon in order to make informed decisions about how to make changes to their way of life that will accommodate the needs of the fish.*

One goal of the volunteer monitoring program at DEQ is to facilitate the collection of data of sufficient quality to meet volunteers' needs. DEQ also attempts to integrate volunteer data collection into agency monitoring efforts. For example, volunteer data may be used in studies to develop Total Maximum Daily Loads (TMDL) for streams placed on the Clean Water Act 303(d) list. DEQ must complete TMDLs for 91 sub-basins by 2007, as illustrated by Figure 1. Hundreds of stream segments are listed for temperature exceedence because cold water aquatic life is one of the most sensitive beneficial uses of Oregon waters. Other common parameters for which water bodies are listed are sedimentation, habitat modification, dissolved oxygen, and bacteria.

Technical support provided by the Volunteer Monitoring Coordinator includes assistance in developing quality assurance plans, training volunteers to use monitoring equipment, verifying their sampling techniques, and assisting them with data submission to DEQ. The Volunteer Monitoring Coordinator works closely with three regional monitoring coordinators in the Laboratory to coordinate volunteer efforts with DEQ data collection.

Volunteer monitors in Oregon usually work through watershed councils and organizations of stakeholders and citizens recognized by the Oregon Watershed Enhancement Board (OWEB). OWEB originated in 1988 to provide technical and financial support to stakeholders actively restoring Oregon waters. Several watershed councils secure funding from OWEB for a paid monitoring coordinator or receive interns from a program called Resource Assistance for Rural Environments (RARE). Technical groups such as soil and water conservation districts and other state and federal agencies work with the Volunteer Monitoring Coordinator to collect and store consistent water quality data.

DEQ purchased high quality monitoring equipment for volunteers with a grant from OWEB in 1998. Purchasing the equipment in bulk and distributing it to volunteers saved tens of thousands of dollars. In addition to the financial savings, the consistency gained from having all volunteers using identical equipment, capable of attaining the accuracy and precision criteria adopted by DEQ, is critical. Volunteers agree to submit a sampling plan, follow certain protocols, and share data with DEQ in exchange for the equipment.

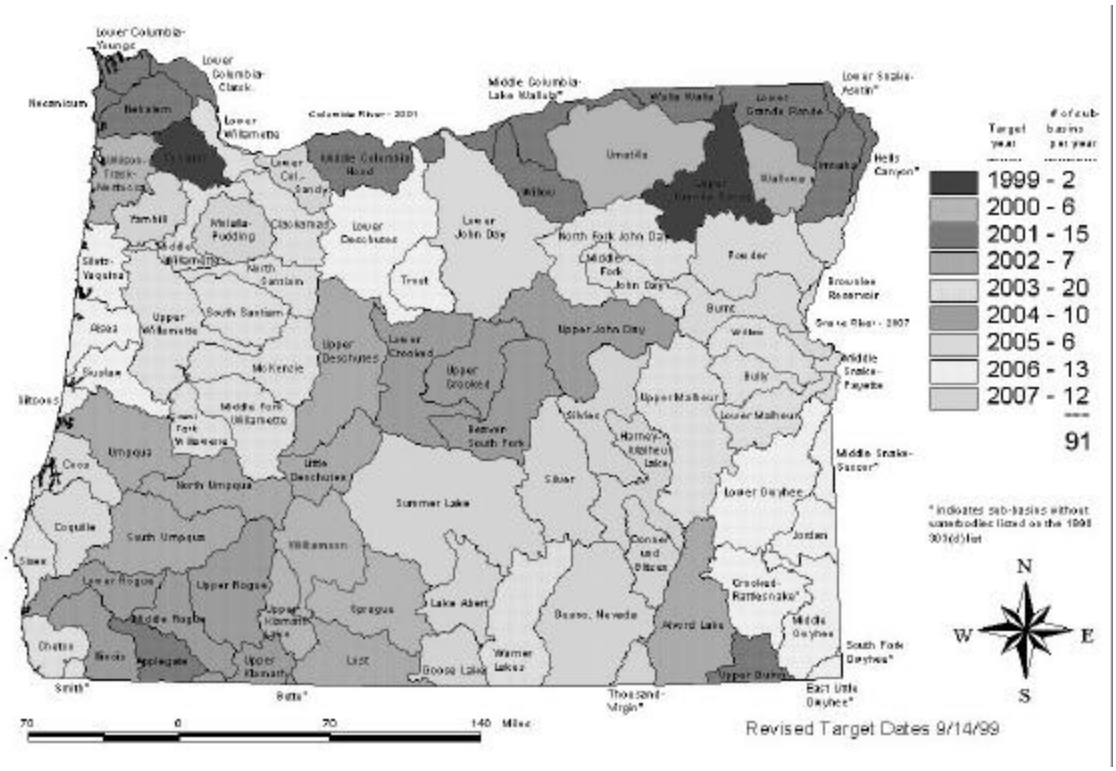

Figure 1: Schedule of TMDLs (for 91 subbasins in Oregon)

Methods of Volunteer Training

Established monitoring protocols are crucial for maintaining consistency among volunteers' techniques. The Oregon Plan monitoring team, comprising representatives from DEQ, and Oregon Departments of Agriculture, Fish and Wildlife, Forestry, and Water Resources, compiled water quality monitoring protocols in a guidebook. Volunteers using DEQ equipment agree to follow the Oregon Plan protocols for measuring pH, conductivity, temperature, dissolved oxygen, turbidity, and collecting macroinvertebrates. The Technical Water Quality Monitoring Guidebook also has chapters to help volunteers design their study, choose sampling locations, and understand the importance of quality assurance and quality control.

Volunteers attend trainings in which they learn to calibrate, maintain, and use the equipment according to Oregon Plan protocols. Trainings also cover Quality Assurance plans, modeled after the EPA *Volunteer Monitor's Guide to Quality Assurance Project Plans.* DEQ provides an example plan on its website from which volunteers may develop their own plans.

Duplicates and split samples between DEQ and the volunteers serve to improve consistency of measurements and data quality. The Volunteer Monitoring Coordinator may duplicate field measurements with volunteers or bring samples back to the DEQ laboratory for analysis. This auditing bolsters volunteer confidence and validates their data to potential users.

DEQ asks that volunteers manage their own data and provide initial quality control checks like duplicate sample agreement or temperature audits of data loggers. Volunteers then assign a data quality level based on these factors as well as meeting the data quality objectives in their sampling plans. If volunteers want their data input into the DEQ Laboratory database, they must submit locational information, e.g. latitude and longitude, river basin, and hydrologic unit. DEQ provides a spreadsheet entitled Data Reporting Format on its website to assist volunteers in organizing their data. Table 1 contains the essential information that must accompany volunteer data.

DEQ attempts to maintain contact with approximately 40 volunteer groups throughout the year, recognizing that participants change, forget methods, and benefit from repeated instruction. The DEQ laboratory website posts copies of the Oregon Plan monitoring protocols and a volunteer monitoring newsletter. The newsletter is a combination of technical articles and those written by volunteer monitors about their projects.

Table 1: An example of information that should accompany volunteer data submitted to Oregon DEQ. HUC = Hydrologic Unit Code; WRD = Oregon Water Resources Department

ORGAN-IZATION	SITE DESCRIP-TION (Location)	ELEVA-TION (ft.)	LAT. DEG.	LAT. MIN.	LAT. SEC.	LONG. DEG.	LONG. MIN.	LONG. SEC.
Volunteer Creek WSC	Volunteer Creek @ Highway 10	1500	45	15	7.7	123	10	27.2
LAT/LONG SOURCE	**RIVER BASIN**	**SUB-BASIN**	**HUC (4th field)**	**RIVER MILE**	**RIVER MILE SOURCE**	**STATION ID**	**DATE**	**TIME**
USGS, Juniper Butte, OR, 7.5" Quad, 1:24,000	Willamette	Yamhill	17090008	25.5	WRD, Hood Drainage Basin, Map 4.6	VC-5	06/09/98	14:30

Volunteers' Motivation and Use of Data

Oregon volunteers begin monitoring for a variety of reasons, but most consider it one of their highest priorities to educate their communities and increase public understanding of the link between land use and water quality. Many take pride in the ownership that comes from testing water quality in their own backyards, whether their interest lies with control of noxious weeds in a coastal lake or tracking the temperature increase in a stream from the forested headwaters to arid range lands. A completed monitoring season is a tangible accomplishment to bring back to the community and may be an element of a watershed council's Action Plan. One volunteer identified a goal of their program: "be safe and have fun." Another group hasn't missed a monthly sampling since summer of 1998 because "we all feel the information has value, we enjoy getting out looking at our streams, and we enjoy each other's company. If one of us can't make it, we always request a re-schedule so we don't miss out!"

Water quality monitoring presents a unique opportunity to involve land owners. The Long Tom (Eugene, OR) and North Fork John Day (Monument, OR) watershed councils have focused on land owner involvement as a portion of their monitoring projects. The Long Tom council is assisting agricultural land owners in collecting samples of runoff from their property and evaluating whether or not land use changes (e.g. planting buffer strips, timing fertilizer application) are resulting in water quality improvements. The North Fork John Day volunteers include enthusiastic science students at Monument High School who serve as water quality ambassadors to land owners in this high desert environment.

Many watershed councils come from areas where the Oregon Department of Agriculture is developing water quality management plans to reduce agricultural non-point source pollution. Several councils are using volunteer data as baseline measurements. They will compare with measurements taken after certain agricultural practices are changed. The Yamhill watershed council, for example (McMinnville, OR), located in the fertile Willamette Valley, has monitored continuous temperature for two years at 20 sites. This data from agricultural lands supplements temperature data collected at the headwaters by the Bureau of Land Management.

Volunteers may begin monitoring because research indicates very little water quality data exist on which to base judgements. This prompted monitoring by the Clatsop watershed councils, located along the north coast, and the North Santiam council, located on a tributary from the Cascade Mountains to the Willamette River. Filling in data gaps can be useful in completing a watershed assessment and in building an understanding of seasonal fluctuations in water quality.

Watershed councils often use their data to identify areas in which riparian restoration is most needed and will bring the most benefit to the aquatic community. The Applegate watershed council (Jacksonville, OR) reviewed three years of field monitoring baseline information and determined that sedimentation, temperature and dissolved oxygen were the parameters of greatest concern. This year they are monitoring tributaries intensively for these parameters. Their priority is to identify, enhance, and protect cold water refugia for salmon.

Volunteers use traditional and electronic means to communicate information. Several councils maintain web pages and update them with current monitoring information. Newsletters circulated to the council and interested

citizens are popular for highlighting monitoring as well as other accomplishments. Local newspapers are also an effective resource to recruit new volunteers, announce workshops, and report findings. Volunteer monitors make regular presentations to their watershed councils, speak at public meetings, and educate the next generation of water quality stewards through local schools.

Agency Use of Data

Watershed councils often intend that an agency use their data. Volunteers must adhere to strict quality assurance and overcome skepticism about volunteer data quality to accomplish this. Volunteer data are more likely to be used if the volunteers have met with DEQ at the beginning of the project to discuss their goals and proposed methods.

Though many volunteers' first contact is the Volunteer Monitoring Coordinator, councils may also work directly with the DEQ regional office near them. The South Coast/Lower Rogue watershed council and Curry Soil and Water Conservation District worked with the DEQ, Coos Bay office on an assessment of riparian conditions. This group supplemented interpretation of aerial photographs with measurements of stream channel characteristics and riparian vegetation. Their results were used to predict site potential for shade and consequently temperature reduction. They also completed inventories of forest logging roads, analyzing such sediment-contributing factors as undersized culverts, poor drainage, and excess erosion.

A volunteer with the Williamson watershed council (Chiloquin, OR) in south central Oregon installed 12 continuous temperature data loggers in the Williamson River and its tributaries. DEQ hired a remote sensing contractor that uses Forward-looking Infrared technology (FLIR) to detect heat given off by a stream and hence, its temperature. The data the volunteer collected is being used to verify the remote sensing information. Figure 2 presents a component of the volunteer-collected Williamson River data.

This season, DEQ will be working intensively in the Nehalem River watershed because the TMDL for this basin is due in 2001. DEQ is using at least two years of continuous temperature data collected by the Upper and Lower Nehalem watershed councils to decide which areas in the watershed need the most intensive sampling this summer. DEQ followed a similar process in 1999 with data collected by the Nestucca-Neskowin watershed council. This council has also provided valuable storm-related bacteria data, being able to respond quickly when storms occur.

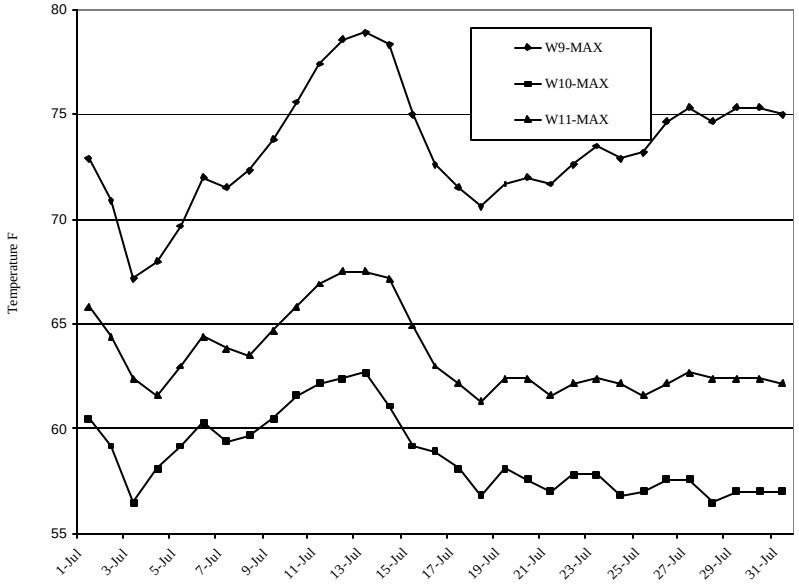

Figure 2: Maximum daily temperatures recorded on the Williamson River -- 50 yards upstream (W10) and 3/4 miles downstream (W11) of a tributary, the Sprague River (W9). *Data collected and processed by Jim Walthers, Williamson Watershed Council, Chiloquin, OR.*

Conclusions

The Oregon DEQ Volunteer Monitoring Program is part of the Water Quality Monitoring Section of the Laboratory. A Volunteer Monitoring Coordinator provides technical resources and guidance to approximately 40 groups. Volunteers have access to high quality monitoring equipment and follow established protocols, which increases the precision of the data collected statewide.

Volunteer monitoring presents challenges to both DEQ and the volunteer participants. As with many volunteer activities, responsibilities often fall on a small group of people, or the watershed council coordinator. Leaders may struggle to maintain interest and commitment among volunteers. Combining monitoring with other watershed activities like tree planting or estuary clean-ups is often successful in keeping volunteers and communities engaged. Volunteer monitors are also occasionally called upon to build bridges with land owners that perceive their relationship to monitors and state agencies as adversarial.

Funding is limited and councils may have to scale back their programs to match their budgets. DEQ has no budget for assisting watershed councils other than the Volunteer Monitoring Coordinator position. Financial support for equipment comes from OWEB each biennium. This requires that DEQ anticipate the needs of councils over the next two years or that councils secure their own funding for resupply or equipment replacement. The Volunteer Monitoring Coordinator works statewide and is not always successful in providing sufficient support and technical guidance to all watershed councils involved. One volunteer commented that "DEQ technical support is a bit nebulous," when the council needs help interpreting the data they collected.

DEQ's largest challenge lies with volunteer data management. Loading volunteer data into the agency database depends on the Volunteer Monitoring Coordinator preparing hundreds of sample locations for entry. Once data has been entered, this database, though containing public information, is not yet accessible via the Internet to the public.

The DEQ volunteer monitoring program begins its third year with the summer 2000 season. Each year brings increased participation and data submission. The potential benefits to communities, DEQ, Oregon's water quality, and ultimately endangered fish populations outweigh any temporary challenges.

References

Oregon DEQ website: www.deq.state.or.us

Oregon Watershed Enhancement Board Water Quality Monitoring Guidebook, July 1999. Order from OWEB, 255 Capitol St., NE, 3rd Floor, Salem, OR 97310-0203.

The Volunteer Monitor's Guide to Quality Assurance Project Plans, U.S. E.P.A., September 1996. Publication number EPA 841-B-96-003.

THE Cs HAVE IT: COLLABORATION, COORDINATION, COMPARABILITY

SESSION INFORMATION:

Moderator:

Abby Markowitz, Tetra Tech

Presenters:

Connie Fortin, Fortin Consulting, Inc.
Minneapolis–St. Paul Area Volunteer Monitoring: A Coordinated Approach for 2000

Ric Lawson, Great Lakes Commission
Coordinating Monitoring in the Lake Michigan Basin

Eric Mendelman, Texas Watch
Coordinating Monitoring in Texas

Across the country, monitoring efforts are focusing on three important Cs– collaboration, coordination, and comparability– as ways to increase the accessibility, efficiency, and effectiveness of data collection and analysis. Volunteering monitoring programs are playing a key role in many of these strategies.

Many of these collaborative efforts are targeted in specific jurisdictional areas (Texas, Minneapolis-St. Paul) while others are watershed or basin based (Lake Michigan). By inviting all the monitoring entities in a given area to *sit at the same table* and work together to develop and implement integrated and coordinated monitoring strategies, these collaborations are one of the ways that volunteer monitoring is *moving into the mainstream.*

This session included presentations about three collaborative monitoring efforts: Minneapolis-St. Paul, Lake Michigan, and Texas. After the presentations, participants engaged in discussion and explored some of the factors that lead to success as well as some of the institutional obstacles, challenges, and pitfalls that exist in developing and maintaining the three Cs.

THE C's HAVE IT: COLLABORATION, COORDINATION, AND COMPARABILITY

Minneapolis-St. Paul Area Volunteer Monitoring: A Coordinated Approach

CONTACT INFORMATION

Connie Fortin
Fortin Consulting
215 Hamel Road, Hamel, MN 55340
phone: 763/478-3606
email: fci@iaxs.net

This paper describes the evolution of volunteer stream monitoring in the Minneapolis/St.Paul seven county metro area. The seven county area drains to the Mississippi River. We are the headwaters state for the Mississippi River and by improving our citizen involvement in river monitoring we hope to have a positive impact on the water quality of the mighty Mississippi. A new coordinated monitoring program has been planned and implementation is just beginning. The program has many goals and objectives. One noteworthy goal is to integrate professional and volunteer monitoring data.

Evolution of Volunteer Stream Monitoring in the Twin Cities

Volunteer stream monitoring has probably always existed in the Twin Cities metropolitan area. For years, people have gone to the stream to look at the water. Data collected was generally unused except for education and personal interest.

- 1995 – Hennepin Conservation District started a macroinvertebrate monitoring program. Each year the program has over 1000 high school and college students in the streams.
- 1997 – Minnesota Department of Natural Resources introduced a volunteer trout stream monitoring program. This involved citizens in several counties, adjacent to Hennepin County. Hennepin County (Minneapolis's County) has no trout streams. This has been a very successful program.
- 1998 – Minnesota Pollution Control Agency started a citizen stream monitoring program. The primary method is transparency tube readings after rain events. This is still a small program with only one site in the metro area.
- 1998 – Metro Association of Soil and Water Conservation Districts ask for legislative money to start a coordinated volunteer stream monitoring program. No funds were allocated.
- 1999 – A steering committee comprised of agencies, nonprofits and private industry was formed to look at how to get a coordinated program started in the metro area.
- 1999 – The Metropolitan Council, a seven county regional agency, awarded funds to plan a metro wide coordinated volunteer stream monitoring program.
- 2000 – The metro monitoring steering committee asked for legislative money for the coordinated program. No decision has been made yet.
- 2000 – The Metropolitan Council awarded $400,000 to start the coordinated program.
- 2000 – The Metropolitan Council agreed to develop and maintain a database that could support the volunteer monitoring program.

In addition to the bulleted items, it is important to note that starting in about 1997, requests for training, advice on how to start a program, and requests to be part of a program started to come in and have steadily increased. This has placed a stress on the existing monitoring resources. At the same time, the agencies were getting increased requests to use volunteer monitoring data. This was difficult for them because each program used different protocols and quality assurance measures, and stored the data differently. It was obvious to everyone involved that it was time to work together and plan a coordinated volunteer monitoring program.

Five year plan for a coordinated monitoring program

A strategic plan was written in 1999 in response to the need for a more coordinated approach to volunteer stream monitoring in the twin cities area. Four goals were brought forth:

- Engaging volunteers
- Involving agencies
- Collecting and managing quality data.
- Implementing the plan

The purpose of the plan is to:

- Provide support for new and existing volunteers, as well as the organizations that support volunteer monitoring.
- Connect water quality monitoring efforts.
- Provide opportunities to compile and interpret data already being collected and expand monitoring to all metro streams.
- Provide meaningful involvement for volunteers by helping citizens access information and identify actions they can take to protect rivers in their communities.
- Build support among citizens and agencies for local and state river protection decisions.

Implementation of the plan
Implementation of the plan starts in 2000. Resources will be obtained through staff or contract means. Initial recommendations are for a water chemist, a water biologist, and an outreach specialist. Supervising and guiding the workforce and the program development will be the metro monitoring steering committee. The Steering Committee reports to an umbrella organization called WaterShed Partners. WaterShed Partners is a group of organizations interested in watershed education. It was the wish of the monitoring community that these efforts remain collaborative and not reside under the direction of any one organization.

It is the goal of this program that the "staff" empower and assist the local monitoring programs, direct interested monitors to appropriate programs, and help organizations start new local monitoring programs. This program will not "take over" any existing programs. Rather, it will strengthen existing programs by offering technical, financial and marketing assistance. We hope that this program will be the hub of the monitoring community and will be able to facilitate discussions among the state, regional, and local monitoring communities.

Combining professional and volunteer monitoring data
In the past, there was little collaboration among volunteer monitoring programs and between the programs and agencies. The monitoring community recognized the need to coordinate monitoring locations, protocols, and data. The good news is there are examples, prior to the completion of the plan, where volunteer monitoring data was already being integrated with professional monitoring data. Integration took place in cases where the volunteer group met with the agency, prior to sampling, to agree upon methods and quality assurance. A few examples of this partnership include:

- 1997 – Hennepin Conservation District wanted MPCA to use their volunteer macroinvertebrate monitoring results in the 305b report to Congress. HCD was able to interpret the results in a manner consistent with other professional data sets so that the results could be combined. According to MPCA "This is the first time we know of that information was derived from student's macroinvertebrate collections about the condition of the stream resources was used for the 305b report"
- 1998 – Stream put on TMDL list for chlorides. Volunteers wanted to monitor chlorides. Local conservation district called a meeting of the watershed, the volunteers, MPCA, and USGS to talk about methods. Recommendation was to have volunteers do a watershed survey of conductivity that could assist professionals in where to conduct their chloride monitoring.
- 1999 – River group wanted information on the river before the turn of the century. Asked MPCA to assist them in selecting a protocol. MPCA and volunteer river group worked together to gather the samples, another nonprofit paid for samples to be analyzed. Since sampling was done using MPCA

protocol, results will be used in MPCA's basin assessment study in addition to being used by the river group.

Using the information learned from the above efforts, the group knew that it was possible to cooperate with agencies to make use of volunteer monitoring data. One of the steering committee organizations, the Metropolitan Council, has agreed to develop and maintain a database for the volunteer monitoring data. This database will be read-accessible to citizens, agencies, or anyone interested in viewing the data. The database will be linked to GIS so that a map of volunteer and professional sampling sites can be produced. The database has not yet been designed and will take a while to be completed. While the database is being designed and built the local monitoring groups will be responsible for keeping track of their data.

Applications beyond the seven county area

The seven county coordinated volunteer stream monitoring program will be implemented this year. The recommendations and strategies in this plan could be applied to monitoring other resources (lakes, wetlands, groundwater) in the metro region or in other basins of the state. The need exists statewide and nationwide for meaningful volunteer involvement, improved communication, increased quality assurance, greater use of volunteer collected data, efficient use of resources and a more comprehensive evaluation of our waters.

> *The future of Minnesota, and of the world, depends on informed citizens making the proper decisions*
>
> – John R. Tester.

References

WaterShed Partners 1999. *A strategic Plan for Coordinating Volunteer Stream Monitoring in the seven-county Twin Cities Metropolitan Area.*

John. R.Tester 1995. *Minnesota's Natural Heritage.* University of Minnesota Press.

THE C's HAVE IT: COLLABORATION, COORDINATION, AND COMPARABILITY

Coordinating Monitoring in the Lake Michigan Basin

CONTACT INFORMATION

Ric Lawson
Great Lakes Commission
400 Fourth Street, Ann Arbor, MI 48103
phone: 734/665-9135
fax: 734/665-4370
email: rlawson@glc.org

For more information:
A website has been established for the Lake Michigan Monitoring Coordination Council at http://wi.water.usgs.gov/lmmcc/index.html.

The Lake Michigan Tributary Monitoring Project final report will be released in early June on the Great Lakes Commission website at http://www.glc.org. For further information on either of these projects or the future projects presented in this paper, contact the author.

Additional information on Lake Michigan, including the LaMP and AOC programs, is available online at http://www.great-lakes.net/places/watsheds/lmich.html.

Several projects have been recently undertaken in the Lake Michigan basin to coordinate monitoring efforts. Both are collaborative approaches with the overall intent to enhance the use of monitoring information collected by a vast array of organizations in the basin. These projects include the *Lake Michigan Monitoring Coordination Council* and the *Lake Michigan Tributary Monitoring Project.* Both projects offer opportunities for volunteer monitoring programs to gain wider use and support for their data collection efforts.

Background

Pursuant to the 1987 protocol to the Great Lakes Water Quality Agreement (GLWQA), Lakewide Management Plans (LaMP) are presently being developed for four of the five Great Lakes. The Lake Michigan LaMP effort is being led by the U.S. Environmental Protection Agency (U.S. EPA), Region 5, in cooperation with its partners in the states of Michigan, Indiana, Illinois and Wisconsin, the public and other federal and tribal agencies. Additionally, Remedial Action Plans (RAPs) are being prepared for ten Lake Michigan tributaries designated as Areas of Concern by the parties to the GLWQA.

While the current draft Lake Michigan LaMP focuses strongly on toxic pollutants, the participating agencies and stakeholders recognize that other stressors contribute to impairments of the lake and the tributaries that feed into it. In response, the LaMP is expanding its scope to address a broader array of management issues, including loss of habitat and biodiversity and introduction of damaging exotic species. The soon to be released draft of the LaMP will include the results of a number of studies and monitoring efforts to determine the fate of pollutants entering the Lake, and how they move through air or water or sediments into the food chain.

A critical component of this broader approach will be a monitoring regime that is coordinated from one jurisdiction to another and sufficiently comprehensive to support the ecosystem indicators which inform management decisions. The Lake Michigan Mass Balance Study will provide important data on the amount of several critical pollutants entering the lake, their movement and how they are made available to fish and plant life. An outstanding need remains, however, to assess the status and scope of monitoring being conducted at the state and local levels on major tributaries to Lake Michigan; to develop a plan for coordinating and enhancing these efforts; and to address gaps and unmet needs in the collective monitoring and reporting regime that hamper decision making at all levels.

Lake Michigan Monitoring Coordination Council

Overview

In the summer of 1999, several federal, state, local, and tribal agencies along with a number of non-governmental organizations formed the Lake Michigan Monitoring Coordination Council (Council) to support resource management efforts in the Lake Michigan basin. The Council responds to the need for enhanced coordination, communication and data management among the many agencies and organizations that conduct or benefit from monitoring efforts in the Lake Michigan basin. The Council provides a forum to identify gaps and establish monitoring priorities; exchange information and form partnerships; and promote standardized methodologies for collecting and managing data to reduce costs and facilitate access to information across agency and jurisdictional boundaries. The Council will work in cooperation with the Lake Michigan LaMP in developing and periodically updating a monitoring plan for the Lake Michigan basin.

Background
The Council reflects and responds to similar initiatives underway at state and federal levels. In 1992 the Intergovernmental Task Force on Monitoring Water Quality (ITFM) was formed to review water quality monitoring activities in the United States. The ITFM's final report recommended a strategy for improving nationwide water-quality monitoring efforts. Specifically, the strategy highlighted the need for comparable and scientifically defensible information, interpretations, and evaluations of water-quality conditions to support decision making at local, state, tribal, interstate and national levels. The 1998 Clean Water Action Plan echoed these recommendations and called for the development of comparable data standards, resource classifications, inventory methods and protocols.

In 1997 the National Water Quality Monitoring Council (NWQMC) was formed as the permanent successor to the ITFM. The NWQMC's purpose is to support water quality information aspects of natural resources management and environmental protection and to coordinate the voluntary implementation of the ITFM's recommendations. The NWQMC includes representatives from federal, interstate, state, tribal, local, and municipal government agencies, industry, environmental groups, universities and volunteer monitoring groups. The NWQMC is co-chaired by USGS and U.S. EPA, with secretariat support provided by USGS. The council is a subgroup of, and reports to, the federal Advisory Committee on Water Information (ACWI). ACWI advises the federal government on activities and programs designed to meet the nation's water information needs. The Water Resources Division of USGS chairs the ACWI and has overall responsibility for the federal government's Water Information Coordination Program. (Additional information on these groups and the Water Information Coordination Program is available at http://water.usgs.gov/wicp/index.html.)

Several states, including Maryland, Colorado and Arizona, have formed water quality monitoring councils to promote collaborative efforts aimed at facilitating the effective collection, interpretation, and dissemination of environmental monitoring data. The Lake Michigan Monitoring Coordination Council is the first such entity to be based on an ecosystem rather than political boundaries.

Mission
The mission of the Lake Michigan Monitoring Coordination Council is to provide a forum for coordinating and supporting monitoring activities in the Lake Michigan basin and to develop and make broadly available a shared resource of information, based on documented standards and protocols, that is useable across agency and jurisdictional boundaries.

Objectives

- Document monitoring activities, identify data gaps and contribute to the development of a monitoring framework for the Lake Michigan basin in conjunction with other plans.
- Establish and maintain collaborative partnerships that link federal, state, tribal, local and non-governmental monitoring organizations and initiatives in the Lake Michigan basin to allow for the assessment of ecosystem resources in the basin.
- Foster the implementation of monitoring activities that document data quality and are comparable throughout the basin.
- Support information networks that link basinwide information systems and allow efficient sharing and updating of monitoring information.
- Provide guidance and assistance to members of the Council so they can improve general awareness of the value of monitoring.
- Assist council members and workgroups with techniques to announce, distribute, and promote their products for use by the Lake Michigan monitoring community.

Membership
Council members are regularly elected and include representatives from the following groups: eight state agencies; seven federal agencies; tribal authorities/associations; business, industry and consultants; agricultural groups; local volunteer or environmental groups; Sea Grant Programs or university-based institutes; Lake Michigan LaMP Forum; local government/planning agencies; and the Great Lakes Fishery Commission.

Status and Activities to Date:
A preliminary meeting was held in April 1999 to establish a process for forming the Council, to discuss the Council's scope and to begin drafting the Council's proposed mission, objectives, and membership structure. Following this meeting, membership was sought from interested organizations and the inaugural meeting held in September. The Council's mission, objectives, formal membership and voting rules, and initial workgroups were drafted at this meeting. Council co-chairs were elected from the USGS and Michigan Department of Environmental Quality following the September meeting. Most of the progress has been accomplished through the workgroups discussed below.

Workgroups
Four workgroups were created at the September meeting of the Council. These workgroups met twice following the meeting, and their progress was further discussed at the April meeting of the Council. The general focus and progress in each workgroup is presented below.

- Data Inventory and Assessment. This group assists the Great Lakes Commission in isolating issues and key contacts for conducting an inventory and assessment of monitoring in the Lake Michigan basin. The first draft of the inventory has been produced, and is now being reviewed by the workgroup. This group will further assist the Commission to ensure full coverage of the basin, provide advice on database and website design to enhance usage, and assist in the assessment and integration of the inventory results.

- Monitoring Objectives. This group explores the key questions and driving forces (e.g. TMDLs, 305b reports, Clean Water Action Plan, etc.) of monitoring projects, and determines which questions are being answered and which are not. Determining where research objective compatibilities and incompatibilities exist is an important function of this group. The group has developed a draft survey for Council members that will catalog the monitoring objectives of programs conducted by member agencies. The workgroup plans to use this information to first examine programs in the area of surface water quality monitoring.

- Watershed Pilots. This group focuses to select collaborative efforts that could be instructive for regional work. These projects can be assessed for lessons learned from successful and unsuccessful monitoring collaborations, as well as recommendations for improvements. This workgroup first developed a list of current collaborative projects in the basin that would be instructive, and selected the Lake Michigan Mass Balance Project as the most useful case study. The group generated a short list of potential follow-up projects that could be carried out through the Council as a pilot effort. The workgroup will next select the most feasible of these projects, and begin work on developing a proposal for carrying out the pilot project.

- Outreach. This group will collect examples of successful monitoring coordination efforts and will seek the most effective ways to highlight the benefits of collaboration and coordination of regional monitoring efforts. This work should encourage support for further Council efforts and establish benchmarks. This workgroup has developed an informational brochure to be distributed widely. It was also determined that this group would seek support for planning a Great Lakes regional monitoring conference to be sponsored by the Council and held in the Lake Michigan basin in Spring 2001.

Lake Michigan Tributary Monitoring Project
To better understand the range of environmental monitoring information available in the Lake Michigan watershed, the U.S. EPA, Region 5, contracted with the Great Lakes Commission to initiate the Lake Michigan Tributary Monitoring Project. The purpose of the project is to obtain a clear picture of local monitoring activities and data being collected in major tributaries to Lake Michigan in the form of a basinwide inventory. Monitoring was examined in the broadest sense, focusing not only on traditional water quality conditions, but also on habitat, wildlife, land use, nonpoint source pollution and other measures of ecosystem health.

The Commission collaborated with locally-based groups in 14 tributaries around Lake Michigan to evaluate monitoring activities at the local level (Figure 1). The participating organizations assessed monitoring being conducted by local agencies, utilities, industries, volunteer and other citizens groups, as well as other entities in their watersheds. The Commission assessed information collected on the Lake Michigan tributaries through state and federal monitoring programs. A GIS-based database of monitoring activities was developed to facilitate broader use of monitoring information and to help decision makers and resource managers at all levels target limited financial resources to critical monitoring needs.

A draft report on this project has been developed and is now in the process of review and revision. The report includes a comprehensive review of monitoring programs at the federal, state and local levels for the targeted watersheds; an analysis of gaps, inconsistencies and unmet needs; an assessment of the adequacy of existing efforts to support critical ecosystem indicators; and a plan for addressing major monitoring needs, particularly those considered most important for lakewide management decision making. The report has also been used at a Spring Workshop to train members of the Lake Michigan Forum, PACs, and other stakeholders to better determine current, local monitoring efforts and establish community-based monitoring programs. This workshop resulted in the support for a volunteer monitoring network (discussed in a later section) to expand and enhance the use of volunteer monitoring data in the basin.

Figure 1: Tributaries participating in the Lake Michigan Tributary Monitoring Program.

The results outlined in the report have been integrated into the Lake Michigan LaMP, and are helping to drive future monitoring work in the basin. A few of the key results include the following:

- The inventory indicates good coverage of basic water quality measures and some toxic pollutants. Physical features such as stream flow and basic chemical components such as suspended solids and nitrogen and phosphorus content are well-monitored in the basin.

- Little information on volunteer monitoring efforts exists in an organized framework, such as a national or regional database. Further work is needed to gain basic information on these programs and include information in regional databases.

- Non-water quality information is not well integrated into the monitoring knowledge base. Information in the areas of wildlife monitoring and land use is scattered and of varying quality.

- Other geographic and parametric gaps exist. Northern watersheds in the basin have limited monitoring coverage for all parameters, and a number of specific parameters exhibit a lack of monitoring coverage throughout the basin.

The project also supported local efforts to restore environmental quality in the ten designated Areas of Concern (AOC) along Lake Michigan. The AOCs include rivers, lakes and bays where significant pollution problems have impaired beneficial uses of the water body. Remedial Action Plans (RAPs) are being implemented in each of the AOCs to clean up sources of pollution and restore the beneficial uses. The tributary monitoring project involves all of the Lake Michigan AOCs and is being coordinated closely with local groups responsible for developing the RAPs.

Volunteer Connections

Building on the projects presented above are two future initiatives which would expand the use of volunteer monitoring efforts in the Lake Michigan basin. The first — an Online Monitoring Database — is a natural follow-up to the Tributary Monitoring Project. Its purpose is to deliver the monitoring inventory over the Internet in a GIS form. The second — a Volunteer Monitoring Network — proposes to link volunteer monitoring efforts with decision-making authorities in the basin. While the Online Monitoring Database is a funded project scheduled to begin in June, the Volunteer Monitoring Network is a proposal in the process of development.

Online Monitoring Database

The Online Monitoring Database project will develop the Lake Michigan Monitoring Inventory Database and integrate it with a map-based Internet interface that can be linked to Lake Michigan watersheds through the Great Lakes Information Network (GLIN) and U.S. EPA's "Surf Your Watershed" web site, among others. Such a product will give decision makers and the public easy access to real-time information about monitoring efforts throughout the Lake Michigan Basin. It also will allow volunteer monitoring efforts to get wider exposure and use. This database and Internet delivery model can be used as a pilot project for similar designs in other lake basins, ultimately building up to a national inventory of monitoring efforts. The database can also be developed further to integrate actual monitoring data at stream-level specificity. This project will build on current monitoring inventory work being conducted in the basin, bringing together information from local, state and federal sources.

Once complete, the online database will be presented in map form, allowing users to search out projects within specific subwatersheds. Within the target geography, the database will be searchable by a variety of monitoring program specifics. The database will include metadata (information about a data set) on monitoring programs that will help users find data sets in which they are interested. The information presented will include linkages to data set owners, monitoring coordinators, and in some cases, directly to a site containing monitoring data.

Volunteer Monitoring Network

Environmental monitoring is conducted by a wide array of entities at all levels of government, academia, the private sector and citizen volunteers. Currently, there is relatively little effective dialogue or structured exchange of monitoring information between government agencies and the public, and between volunteer monitoring groups and decision makers. Enhancing public dissemination and interpretation of monitoring information by government agencies is a widely recognized priority. Volunteer monitoring programs also represent an important and largely unutilized resource. In short, there is an outstanding need to expand the reciprocal exchange of monitoring information–both "up-down" from agencies to the public, and "down-up" from citizen volunteers to government agencies, policy makers and elected officials (Figure 2).

The goal of the Lake Michigan Volunteer Network is to support ecosystem management efforts in the Lake Michigan Basin by expanding and enhancing the collection, dissemination, interpretation and utilization of environmental monitoring information among all relevant parties in the basin. The network's objectives are to

- enhance local volunteer monitoring efforts and establish a cooperative volunteer monitoring program within the watershed of each major tributary to Lake Michigan;
- utilize volunteer monitoring information to support resource management decision making at the local, state and federal levels;
- expand and improve the dissemination and interpretation of monitoring information collected by public agencies;
- standardize the collection of volunteer monitoring information so it is consistent and comparable across

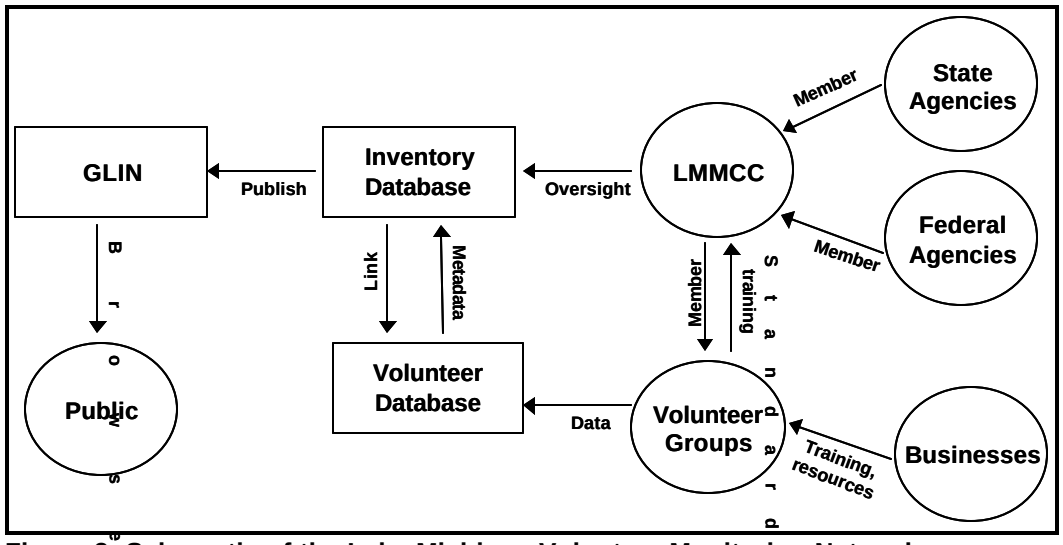

Figure 2: Schematic of the Lake Michigan Volunteer Monitoring Network.

the Lake Michigan Basin; and

- address gaps and unmet needs in the collection, dissemination and utilization of monitoring information.

The initiative would leverage the resources already organized through the Lake Michigan Monitoring Coordination Council. The Council strongly supports the idea, has the requisite technical expertise and includes all necessary stakeholders and project partners. A partnering entity (e.g., water resources institute) will be identified within each state to coordinate outreach to volunteer monitoring groups and provide training and technical guidance. Basinwide and local industry groups (e.g., Council of Great Lakes Industries) will be solicited to coordinate and/or provide financial support and technical services (e.g., lab analysis) to local volunteer monitoring groups. This might include a basinwide sponsor; a sponsor for each state program; and a sponsor within each watershed. Using GLIN as a primary vehicle, the Commission would develop a comprehensive communications program for disseminating and interpreting monitoring information (both "up-down" and "down-up").

Acronyms

ACWI	Advisory Committee on Water Information	ITFM	Intergovernmental Task Force on Monitoring Water Quality
AOC	Area of Concern	NWQMC	National Water Quality Monitoring Council
GLWQA	Great Lakes Water Quality Agreement	RAP	Remedial Action Plan
GIS	Geographic Information System	US EPA	United States Environmental Protection Agency
GLIN	Great Lakes Information Network	USGS	United States Geological Survey
LaMP	Lakewide Management Plan		

THE C's HAVE IT: COLLABORATION, COORDINATION, AND COMPARABILITY

Coordinating Monitoring in Texas

CONTACT INFORMATION

Eric Mendelman, Coordinator
Texas Watch Program
Southwest Texas State University
Department of Geography, ELA 369
601 University Drive, San Marcos, TX 78666
phone: 512/245-1409, fax: 512/245-2095
email: em20@swt.edu

Texas Watch, Texas's statewide volunteer monitoring program, is based in the Department of Geography at Southwest Texas State University and is funded through an interlocal contract with the Texas Natural Resource Conservation Commission (TNRCC). The Texas Watch contract is managed through TNRCC's Water Quality Standards and Assessment Section–which implements both the Federal 319 Nonpoint Source Pollution (NPS) program and the Texas Clean Rivers Program (CRP).

The CRP was initiated in 1991 by the Texas Legislature with the passage of the Texas Clean Rivers Act. The Act was passed in response to growing concerns that water resource issues were not being addressed in a holistic manner. The legislation requires that water quality assessments be conducted for each river basin in Texas using an approach that integrates water quality issues within a river basin or watershed. To fund the program, the TNRCC assesses a fee from permit holders for water use and wastewater discharges. The legislation directs the TNRCC to summarize basin-wide assessments into a comprehensive statewide assessment report in even-numbered years. The Act also requires the TNRCC to develop rules and to implement a program to issue wastewater discharge permits on a watershed basis. All permits within a given watershed are issued in the same year.

Coordination
TNRCC integrates the assessment and permitting functions of the agency through a Statewide Basin Management Schedule which includes a 5 phase approach to Basin Management. The 5 phases, which are implemented over a 5 year period, include issue scoping; data collection and assessment of water quality; targeting of prioritized problems; and strategy development and implementation, including permit review and approval. The program is implemented by TNRCC in partnership with 15 regional agencies, including river authorities, municipal water authorities, and regional councils, who conduct regional water quality assessments in the 23 river and coastal basins of Texas. In each of these basins there is a designated partner agency (the contractor) who has primary responsibility for surface water quality assessment.

Annually, the partner agency and TNRCC conduct coordinated basin monitoring meetings to establish a comprehensive monitoring schedule. This year, volunteer water quality monitoring sites will be included in this planning process for the first time. The data collected through these assessments is submitted to the TNRCC and used to produce the statewide water quality inventory, known as the 305(b) report, and the list of impaired waters or 303(d) list.

Comparability
All programs collecting data under the NPS and CRP programs, including Texas Watch, are required to develop a Quality Assurance Project Plan (QAPP) which references US EPA approved methods and protocols. The CRP provides partner agencies with a QAPP shell containing standardized QAPP language, including data quality objectives and monitoring schedule tables, and a format for data management plans.

Collaboration
Collaborative monitoring projects which include both volunteers and professionals build trust, communication, and respect. This serves as a foundation for drawing volunteer monitoring into the water quality assessment mainstream. A collaborative project provides opportunities for volunteers and professionals to exchange valuable information about a monitoring site and the water quality concerns associated with it.

This year Texas Watch is coordinating a one day Earth Day sampling event on April 18. Professionals and volunteers are invited to sample on the same day and submit their information to Texas Watch where it will be posted to the Texas Watch web page in real time. The goal for participation is 2000 volunteers and professionals. Although the goal of this event is not necessarily to scientifically assess water quality statewide on April 18, it will create unique opportunities for professionals and volunteers to be publicly recognized for their committed efforts to protect water quality in Texas.

Additional collaborative efforts include a joint sampling project on the Colorado River in which a Colorado Riverwatch volunteer and TNRCC professional will sample the same segment of the Colorado River. Data produced last year by the volunteer resulted in the segment's listing on the 303(d) list. This year the TNRCC will be sampling upstream from the volunteer's site to verify the data which support the listing.

The Caddo Lake Institute in East Texas, formerly a strictly volunteer program, has been sampling under contract with the CRP program. Monitors who began sampling as volunteers are now sampling as professionals. The severity of the water quality risks near Caddo Lake, the urgent need for data, and the quality of the volunteer sampling program were key factors in the migration of volunteers to professional status.

INNOVATIVE COASTAL MONITORING TECHNIQUES

SESSION INFORMATION:

Moderator:

Ellie Ely, *Volunteer Monitor* newsletter

Presenters:

Mary Enstrom and Sherry Dawson, The Nature Conservancy
Underwater Citizen Science in the Florida Keys National Marine Sanctuary

Peter Milholland, Friends of Casco Bay
Test Kits– A Handout on Tricks of the Trade

Lori Scinto, Puget Sound Water Quality Action Team
The Shoreline Alteration Citizen Monitoring Protocol– A Project Developed by Island County/Washington State University Beach Watchers

Riley Young-Morse, University of Maine Cooperative Extension
Real-Time Detection of Toxic Phytoplankton

INNOVATIVE COASTAL MONITORING TECHNIQUES

Underwater Citizen Science in the Florida Keys National Marine Sanctuary

CONTACT INFORMATION

Mary Enstrom, Director, Volunteer Stewardship Exchange
email: menstrom@tnc.org

Sherry Dawson, Volunteer Stewardship Coordinator
email: sdawson@tnc.org

The Nature Conservancy
2250 Overseas Highway, Marathon, FL 33505
phone: 305/289-9060, fax: 305/289-9084

The Nature Conservancy is a non-profit conservation organization that is dedicated to preserving plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. The Nature Conservancy opened an office in the Florida Keys in 1987. The Conservancy's work in the Keys is dedicated to working with public and private partner organizations to promote environmental conservation and compatible human activities. To this end, the Conservancy has created the Volunteer Stewardship Exchange (VSE). The VSE is a service that supports organizations working to protect the natural environment. VSE acts as a source of information, fosters collaboration among a wide range of people and organizations, and recruits, trains, and services a network of active conservation volunteers. Currently the largest partner of The Nature Conservancy of the Florida Keys is the Florida Keys National Marine Sanctuary.

One of the great challenges facing the Florida Keys National Marine Sanctuary is to monitor ecological conditions and detect significant changes in animal and plant populations, community composition, and ecological processes. For this purpose, a small percentage of the Sanctuary area has been set aside as special reserves where human activity is restricted or prohibited. Researchers are monitoring the abundance and size of organisms, as well as other parameters, inside these zones and in reference sites of comparable habitat. By comparing the results from inside the zones with results from outside the zones, the effect of marine zoning can be determined over time.

To help meet the challenges the Sanctuary faces, The Nature Conservancy of the Florida Keys developed the ***Sea Stewards*** program. This program is designed to help meet the objectives of the Sanctuary's Research and Monitoring Action Plan by engaging Florida Keys residents in ecological monitoring activities. The program is specifically focused on the needs of the Sanctuary's monitoring program by:

- Targeting species and ecological processes not otherwise monitored
- Providing useful data to the five-year evaluation of the protective zones within the Sanctuary
- Engaging keys residents and Sanctuary users in evaluating the condition of Sanctuary resources and the effectiveness of Sanctuary management

Sea Stewards volunteers are assigned to a reef within a marine protected zone, known as a Sanctuary Preservation Area, where human use is allowed but taking or disturbing any marine inhabitant is prohibited. They are also assigned to a nearby reef with similar habitat where no restrictions are placed on human activity. Within each of the assigned reef areas, Sea Stewards monitor a previously mapped area for the abundance of two species of damselfish and four species of sea urchins. In addition they report the occurrence of "fish-cleaning stations," which are areas on the reef where fish and eels come to be cleaned of parasites, algae, and diseased skin patches by cleaner shrimp and fish. Sea Stewards count and note the species of the "clients" and count the cleaners, such as neon gobies, juvenile porkfish, banded coral shrimp, and spotted cleaner shrimp.

By comparing the data from the restricted and the unrestricted areas, scientists and managers hope to be able to evaluate the primary or secondary effects of ending all fishing and other taking activities in the marine protective zones. An example of primary effect would be an increase in the number and size of a species that, before zoning, has been taken from the area—such as lobster or grouper. An example of secondary effect would be if the increase in predators, such as grouper, caused a decrease in the number of prey species, such as damselfish.

The management plan of the Florida Keys National Marine Sanctuary went into effect in July 1997 and must be evaluated in 2002 to determine its effectiveness in protecting marine biodiversity and enhancing human values related to the Sanctuary. The data collected by Sea Stewards volunteers will be an important component of this evaluation.

INNOVATIVE COASTAL MONITORING TECHNIQUES

Test Kits– A Handout on *Tricks of the Trade*

CONTACT INFORMATION

Pete Milholland, Citizen Stewards Coordinator
Friends of Casco Bay
2 Fort Road, South Portland, ME 04106
phone: 207/799-8574, fax: 207/799-7224
email: pmilholland@cascobay.org

Presentation highlights:

- **Know your test kits!**
  - Gather all the information you can about the equipment in your kits
  - Include Material Safety Data sheets, poison control hotline # for your state and local area
  - Can you lock your kit so young children cannot get in them and harm themselves?
  - What can you add to them to improve the accuracy of the data you are going to collect?

- **Dissolved Oxygen tips**
  - Add a third DO bottle to your kits to increase repeatability of the samples being processed
  - Use a direct reading titrator tip to decrease the size of each droplet of thiosulfate to be 0.1 mg/l
  - Include a graduated cylinder in your kit to accurately measure the exact amount of solution to be processed

- **Sampling Buckets**
  - If possible, splice a line onto the bail of your bucket to reduce the possibility of losing it while sampling
  - Drill a hole at a specific height to assure a repeatable volume of water being sampled every time you sample
  - Also, by drilling a hole in your bucket, you can reduce the chances of sample contamination from constantly putting your hands in the bucket.

- **Know your chemicals**
  - Find out what the shelf life is for EACH chemical reagent in your kit
  - Label each bottle (and cap) with expiration date, and number each in the order of when it is to be added to the sample
  - Consider buying chemicals in bulk and save well-earned money

- **Extras to add to your kits**
  - Magnifying lens to see the markings on titrators and hydrometers better
  - Stick with yarn as a wind indicator
  - Bait bags to attach to the end of your Secchi disk

- **Working with your vendor**
  - If you are working with a water quality kit that does not quite meet your specifications, ask your vendor if they will help create a kit that includes all that you would want. Most vendors are willing to help modify their kits– especially if they know that you are going to be purchasing many of them, or if there is a need for these modifications by other groups.

INNOVATIVE COASTAL MONITORING TECHNIQUES

The Shoreline Alteration Citizen Monitoring Protocol – A Project Developed by Island County/Washington State University Beach Watchers

CONTACT INFORMATION

Lori Scinto, Environmental Scientist
Puget Sound Water Quality Action Team
PO Box 40900, Olympia, WA 98504-0900
phone: 360/407-7337, fax: 360/407-7333
email: lscinto@psat.wa.gov

Overview

In the spring of 1999, under a Public Involvement and Education (PIE) Fund contract with the Puget Sound Water Quality Action Team, Island County/WSU Beach Watchers worked in conjunction with four other Puget Sound citizen monitoring groups to develop a protocol for measuring shoreline alteration (also referred to as shoreline armoring or hardening). The Action Team was concerned with measuring shoreline alteration because a 1994 British Columbia/Washington State Marine Science Panel Report cited near shore habitat loss as the greatest environmental threat to the health of Puget Sound; shoreline alteration directly contributes to near shore habitat loss.

The Beach Watchers measured the extent of shoreline armoring on approximately 125 miles of Whidbey Island's 155-mile shoreline, producing a shoreline alteration percentage similar to that reported by professional scientists at the Washington Department of Natural Resources. The Puget Sound Water Quality Action Team distributed Beach Watchers' final report on the protocol to appropriate planning staff and elected officials from counties, cities and tribes in Washington State.

Project Development

Preliminary work for the project included development of a survey form and instruction sheet that Beach Watcher volunteers could use in the field. Beach Watchers designed the survey form to document man-made structures including bulkheads, sea walls, docks, jetties and groins along the shoreline. This form can be used on variable length beach sections as well as on 150-foot beach sections. (The 150-foot sections were already in use by two other Puget Sound citizen monitoring groups that participated in the project. These groups use 150-foot segments for monitoring various near shore and estuarine parameters because this is a common shoreline property lot size delineation for the counties in Puget Sound).

Beach Watchers explored a variety of tools for measuring shoreline hardening including TOPO! Interactive Maps on CD ROM, Rolatape®, electronic chartmeters, etc. Beach Watcher volunteers used the Rolatape® to measure stretches of shoreline containing shoreline alteration. (Volunteers used the instrument to measure both shoreline hardening structures as well as unaltered segments between those structures on any given stretch of beach). They used either the TOPO! software or the electronic chartmeter to measure long stretches of unaltered shoreline. The TOPO! software contains a drawing function, which allows tracing of the high tide line on the map in order to obtain a length for any given segment of shoreline. Beach Watcher volunteers also printed out copies of TOPO! maps for use with the electronic chartmeter. The chartmeter was then used to trace the distance of any given segment directly on the printed map. (The Beach Watchers found that measurements obtained through the use of the TOPO! software and the electronic chartmeter were comparable. However, the TOPO! drawing program was more user friendly than the chartmeter). After volunteers collected the data for 125 miles of shoreline, the Beach Watchers developed a database and completed the process of data entry.

Training consisted of a demonstration of the measuring tools and an explanation of the survey form. Each participant was given an instruction sheet explaining the protocol. A poster-sized map of Whidbey Island was available at the training session for volunteers and project team members to select and mark off sections of shoreline they wanted to survey. Interest from the Whidbey Island community was so strong that the Beach Watchers ran out of shoreline before it could assign all of its volunteers.

Results and Products

The Beach Watchers measured the extent of shoreline armoring on approximately 125 miles of Whidbey Island's 155-mile shoreline. (The group intends to measure the 30 miles still remaining. There are some volunteers who have not yet surveyed their sections and on some sections, there were access issues that the group is still working to resolve).

The data showed that just over 22% of Whidbey Island's shoreline had been altered. This result was very similar to Washington Department of Natural Resources' finding of just over 20% alteration for the entire 155 miles of Whidbey Island shoreline. The Beach Watchers produced a 30-page report describing the project and results. The Puget Sound Water Quality Action Team published Beach Watchers' data in its biennial report on the health of Puget Sound, the *2000 Puget Sound Update*. The Action Team also recently distributed Beach Watchers' final report on the protocol to appropriate planning staff and elected officials from counties, cities and tribes in Washington State so that they would know that it is available for their use in activities such as gathering data for revisions to county shoreline master programs.

Conclusion

Beach Watchers' shoreline alteration survey shows that trained citizen monitors can quickly compile significant data on a critical feature of near shore habitat. Long stretches of shoreline can be inventoried in a relatively short period of time (in this case, in less than two months), providing a snapshot of conditions during a particular season. Because the data can be easily compiled, it would be possible to repeat the survey over time (e.g., every three to five years) to monitor changes. This shoreline alteration data will be of interest to county planners, policy makers, citizens who live on shoreline property and others.

INNOVATIVE COASTAL MONITORING TECHNIQUES

Real-Time Detection of Toxic Phytoplankton

CONTACT INFORMATION

Riley Young-Morse
University of Maine Cooperative Extension,
235 Jefferson Street, P.O. Box 309
Waldoboro, Maine 04572
phone: 207/832-0343, fax: 207/832-0377
email: rmorse@umext.maine.edu

Introduction

Phytoplankton species such as *Alexandrium spp.*, *Dinophysis spp.*, *Prorocentrum spp.*, or *Pseudo-nitzschia spp.* can pose a threat to shellfish safety and public health (Table 1). These types of phytoplankton may "bloom" in a given area when conditions are right, and an active monitoring project can be extremely effective in promoting shellfish safety to the public by identifying these organisms and determining when they are present. If shellfish ingest the toxic phytoplankton they are not affected, but they carry the marine biotoxin. If a human ingests the shellfish carrying the toxin, it may result in sickness, and in rare instances death, depending on the toxin involved. Certain phytoplankton species can also pose a threat to finfish (Table 2). These species can cause gill irritation, clog gills, or deplete the water of oxygen.

Table 1. Some toxic phytoplankton important in the U.S. (from The Volunteer Monitor, Vol. 10, no. 2 Fall '98)
*Human Illness on Canadian east coast; marine animal illness on U.S. West Coast

Phytoplankton	Illness Caused	U.S. Outbreaks	Symptoms
Alexandrium	PSP (Paralytic Shellfish Poisoning)	New England; West Coast	Numbness of lips and fingers; lack of coordination. Respiratory failure in severe cases. Can be fatal
Pseudo-nitzschia	ASP (Amnesiac Shellfish Poisoning)	No human illness reported in U.S.	Abdominal cramps, disorientation. Permanent memory loss in severe cases. Can be fatal
Gymnodinium breve	NSP (Neurotoxic Shellfish Poisoning)	Southeast coast; Gulf of Mexico	Gastroenteritis; painful amplification of sensation. No deaths have been reported
Dinophysis spp.	DSP (Diarrhetic Shellfish Poisoning)	No human illness reported in U.S.	Gastroenteritis. Nonfatal.

Table 2: Effects of harmful phytoplankton on finfish (from: Manual on Harmful Marine Microalgae. Hallegraeff, G.M. et al (eds.). IOC Manual and Guides No. 33, UNESCO 1995.

Species	Harmful Concentration	Reference
Chaetocerous convolutus	>2-5 cells/ml for Salmonids , irritates gill causing the production of mucus, which may lead to blood hypoxia	Bell, 1961;Rensel, 1993; Taylor, 1993
Alexandrium tamarense and A. fundyense	Food web accumulation-not well documented	White, 1980; Mortenson, 1985;
Gyrodinium aureolum	Gill Damage	Jennifer Martin, 1998
Ceratium fusus	Gill Irritation	Rensel and prentice, 1979
Noctiluca miliaris	Gill Damage	Okaichi and Nishio, 1976
Phaeocystis pouchetii	Mucus clogs gills	Gaines and Taylor, 1986
Mesodinium rubrum	Depletes 0^2	Jennifer Martin, 1998
Heterosigma spp	Strips gills of mucus, leading to osmoregulatory problems	Okaichi *et al.*, 1989, Onoue *et al.*, 1990; Tanaka *et al*., 1994

In Maine, monitoring for marine biotoxins is conducted by the Maine Department of Marine Resources (DMR), which monitors for **Paralytic Shellfish Poisoning** (PSP), caused by *Alexandrium spp.* Detection of PSP by regulatory agencies has been responsible for causing closures of shellfish harvest areas Gulf-wide. In addition to threatening public health, it can result in extreme revenue loss to shellfish harvesters. There are additional species of toxic algae which could potentially be present in Maine waters, for which monitoring is not generally conducted. These algae include; members of the *Pseudo-nitzschia* genus, which can cause **Amnesiac Shellfish Poisoning** (ASP); some species of the *Dinophysis* genus, and *Prorocentrum lima* which can cause **Diarrhetic Shellfish Poisoning** (DSP). Harmful Algal Blooms (HAB's) caused by non-toxic species can also present serious issues to both shellfish and finfish aquaculturists.

HAB's are increasing in severity, geographic distribution, and in species being adversely affected. Volunteer based monitoring efforts have proven to play an integral role in providing essential data on algae blooms which aids the DMR in quantifying marine biotoxins in Maine.

The Maine Phytoplankton Monitoring Program began in 1996, when the need arose to enhance the capacity to detect harmful algae, particularly *Alexandrium spp*. which carries the toxin known to cause PSP. The University of Maine Cooperative Extension, in collaboration with the Maine Department of Marine Resources and the US Food and Drug Administration, worked together to create an innovative volunteer-based phytoplankton monitoring program. This program was designed to supplement the traditional state-conducted biotoxin monitoring programs by looking for phytoplankton species in the water column that are potentially carrying toxins, and can be observed prior to the detection of toxicity in the shellfish. Toxic phytoplankton can show up several days before the shellfish themselves become toxic. HAB's have also been observed to begin in one area and spread out to other areas over time. This real-time data collection provides an almost instantaneous picture of what is happening in the water column at the time the sample is taken.

This program has two major objectives: to assist regulatory agencies with marine biotoxin monitoring efforts by providing early-warning detection of potentially toxic phytoplankton; and to determine if a correlation exists between potentially toxigenic phytoplankton in the water and a toxic event in shellfish.

The program in Maine currently has 25 monitoring groups covering 40 sampling locations along the coast of Maine with approximately 80 volunteers. Volunteers monitor weekly from April through October and send data reports directly to the biotoxin team at DMR, where to date there are over 1800 data entries on phytoplankton populations from the volunteers. The monitoring groups have collected data on the abundance and distribution of phytoplankton in Maine waters that could potentially affect public health. Over time, these data will also contribute to the growing body of knowledge on phytoplankton in the Gulf of Maine, which can be utilized by scientists to identify trends in abundance and distribution of phytoplankton.

The Maine Phytoplankton Monitoring program has been very successful with trained citizen groups conducting this monitoring. Staff have developed standard operating procedures and sampling protocols and have conducted a yearly refresher training program for all monitors. Guidelines have been established for volunteers to record their observations on the various species of algae. Results are transmitted to DMR via fax, using data collection sheets. The volunteer data are stored in a computer database at the DMR laboratory in Boothbay Harbor.

Methods

The volunteers conduct a qualitative count of phytoplankton, noting the relative abundance of target species, and reporting these observations as undetected, rare, common or abundant.

- **Collection of samples:** Using a 20 micron, 1-meter long plankton net, three minute tows are conducted. The sample is concentrated into a collection bottle at the cod end, and removed for examination. Additional measurements of temperature, dissolved oxygen, and salinity can be taken at this time.

- **Examination of sample:** Using capillary tubes, a small amount of the sample is drawn up from the collection bottle. The capillary tube is placed on the stage of a field microscope and examined immediately at 100X magnification. Three fields of view are counted for each capillary tube, and two tubes are examined for each sample (for a total of 6 fields of view). The entire number of organisms found in the field of view is noted, as well as the number of target species. In addition, dominant species are noted on the data sheet.

- **Real-time reporting:** Data sheets are faxed to DMR upon completion. This allows the biotoxin scientists at DMR to act immediately if potentially toxic species are detected in an area.

Volunteers and students involved in this project sample at least one time per week (preferably twice a week when blooms begin). If potentially harmful algae is detected in an area, additional samples are taken to further monitor the presence and abundance of these organisms. This is important in gaining a broader understanding of when and why harmful algae species are blooming, and factors that might be responsible for the blooms, such as light, temperature, nutrients and food supply. (For approximate operating costs and list of equipment used see Table 3.)

Table 3: Equipment used and approximate operating costs.

Equipment	Approximate Cost
Field microscopes	$600
Plankton nets	$100
Collection bottles and capillary tubes	$20
Thermometer	$5
Additional Equipment	**Approximate Cost**
Refractometer (salinity)	$150
Dissolved Oxygen meter	$1200
Digital Camera (to verify identification)	$200-$1000
Video Camera (to verify identification)	$300-$800

Program Successes

The benefit of a real-time phytoplankton detection program has already been observed. Over the last few sampling seasons, *Alexandrium spp*. cells have been detected days prior to toxicity showing up in the shellfish. Another success of the program was the observation of the presence of large numbers of *Dinophysis spp.* in Maine, a genus known to have species responsible for causing Diarrhetic Shellfish Poisoning (DSP). *Dinophysis* was known to exist in Maine, but not to the extent it was being reported by volunteers. This attracted the attention of researchers, and resulted in efforts to address these new findings. The results of the study indicated that the species of *Dinophysis* found in Maine were not toxic, and that another species known to cause DSP was present in Maine, *Prorocentrum lima* (Morton 1999).

New Directions

This program has already increased knowledge of harmful algal blooms along the coast of Maine. Using information from citizen gathered data, new protocols have been developed for quantifying cell counts and a methodology is being developed for sampling an epiphytic species of phytoplankton believed to be associated with diarrhetic shellfish poisoning (DSP) in Maine (Morton et al, 1999.)

This year, we will be incorporating more area aquaculturists into our growing network. HAB's are an important issue for both shellfish and finfish aquaculturists. These sampling protocols can easily be used to monitor around finfish pens and shellfish operations. It would be advantageous for aquaculturists to be aware of the presence of toxic species, or blooms of species known to cause fish kills that might be occurring near fish pens and shellfish farms so that preventative measures may be taken if necessary. This year, the Maine Phytoplankton Monitoring Program is also participating in a research project with Woods Hole Oceanographic Institute by taking coastal quantitative samples of phytoplankton. This relationship to the scientific community strengthens the credibility of the program, and empowers citizens by linking them to research in the Gulf of Maine.

Conclusion

To date, an extensive database containing information on phytoplankton populations along the coast of Maine has been generated. With the help of these data, it might be possible correlate the toxic phytoplankton in the water column with toxins present in shellfish such as mussels, surf clams, and soft-shell clams. If a correlation does exist, real-time information can be incorporated from this project into the PSP monitoring program and be used as an early indication system for marine biotoxins.

Literature cited

Morton, S.L. et al. 1999. Evidence of diarrhetic shellfish poisoning along the coast of Maine. *Journal of Shellfish Research.* 18:681-686.

INTRODUCTION TO DATA MANAGEMENT AND THE STORET APPROACH

SESSION INFORMATION:

Moderator:

Jeff Schloss, UNH Cooperative Extension

Presenters:

Jeff Schloss, UNH Cooperative Extension
Data Management Systems: Some Basic Considerations

Marty McComb, USEPA Region 8; Patrick Detscher; Florida Department of Environmental Protection; Alice Mayio, USEPA
The STORET Approach

INTRODUCTION TO DATA MANAGEMENT AND THE STORET APPROACH

CONTACT INFORMATION

Jeff Schloss
University of New Hampshire
Cooperative Extension-Water Resources
224 Nesmith Hall, 131 Main St., Durham, NH 03824
phone: 603/862-3848, fax: 603/862-0107
email: jeff.schloss@unh.edu

Introduction to Data Management: Some Basic Considerations

While the primary goal of this session is to provide you with an overview of the STORET data base system, it is the first of a series of sessions that will deal with different approaches and tools for data management. These additional sessions will include demonstration sessions for STORET as well as spreadsheet software (Excel); additional data base systems such as EDAS (Ecological Data Application System) and web based data entry. To better decide what approach is the best for your program, we need to take a step back and consider the various factors that should lead you through the decision process.

In a perfect world, this decision would be a "no-brainer." As a model volunteer monitoring program you would have already completed an extensive study design, consulted with your participants, stakeholders and data-users, and received final input from your technical advisory committee and steering committee, to produce clear and concise data collecting, analysis and reporting objectives. Of course this would all be documented in your Quality Assurance Project Plan. But let's be realistic here! You most likely have a program well underway and now its time to sort out how to deal with your data.

"Sort out" is a good lead-in to data management. Think of all of the things you need to keep track of: the who, what, where, and how of your sampling program, the summaries of your data that will lead you through to your findings and conclusions, the stories you want to tell from your data. This is the stuff that is written on field data sheets, lab analysis results and chain of custody forms. In addition, how are you to capture weather and water conditions, special observations, QA/QC samples, or sample preservation details from those field data sheets? From your lab data sheets or reports do you have raw or calculated results or both? What are your reporting units? Do you need to capture holding times or special comments? Would someone outside of your program using your data know these details? Details about your data are termed metadata. Metadata becomes extremely important when you coordinate data obtained through different programs or put out your data for sharing. Some database systems, like ST ORET, can capture much of this metadata and display it on demand. Other volunteer programs have found it more convenient to list these details in separate files made available to data users.

Metadata is just one consideration when evaluating data management systems. All systems offer some approach to organizing our data. Most serve to archive our data for future use. Some allow us to streamline and validate the data entry process. For example, the system will react to a pH that is entered above 14 by causing the computer to beep or an error message to appear. Or a more complicated system may "flag" a secchi disk entry that is deeper than the site depth previously entered. Differences also occur as how these systems sort and subset data for our data summaries. Some can only offer basic summaries while others can calculate specific metrics and extensive statistical summaries. Some allow for extensive "relational" selection, sorting and grouping through complicated data queries that can search through the data and pull out only those entries that meet multiple criteria or can be linked in some way. The latest systems can even include and display locational (spatial) data or work in conjunction with Geographic Information Systems.

Many of us start at the most basic of questions- should our data management system be built using a spreadsheet or database system? Some of the pros and cons to each type are listed in Table 1 below. Advances in hardware and software are starting to blur some of these distinctions as spreadsheets now offer database functionality and databases are becoming user-friendlier. Some programs choose to use both types of systems where one is used as the data entry or archiving tool while the other is used to create summaries, reports or graphics.

In addition, there may already be a system out there that has already been developed for programs similar to yours. There are important "big picture" considerations here that involve an assessment of your resources both monetary and in the computer expertise your program has. Along the same lines, what is available as outside support? What is the long-term outlook on these resources? If you are relying on a volunteer to support your data management efforts and you lose that volunteer, will you still be able to run the system? If you are relying on someone else's software, will it be upgraded and maintained? Then there are the best-fit considerations like how well the system conforms to your data entry structure and data analysis and reporting needs.

Table 1. Some Pros (+) and Cons (-) of Spreadsheets and Databases

Spreadsheets	Databases
+ Have an easier learning curve	– More training needed to use
+ Easier to calculate formulas and conversions	– Harder to program
+ Easier to generate graphics	+ More efficient for large data sets
+ Can set up "templates" for consistent entry and analysis	+ Can relate and connect different types of datasets
– Queries are more difficult and less powerful	+ Can be designed to look like datasheets for ease of data entry and can flag errors
– Hard to link different types of data sets	+ Perform extensive relational queries
– Not as efficient for large data sets	+ Can template summaries and report output

There are also many little details, all of which cannot be covered here, that need consideration. These range from how the system handles missing data, below detection limit situations (TNTC, below detectable limit, secchi disk bottom outs, etc), suspect values and comments. For data management you really need to sweat the small stuff, as it will come back to haunt you (read: screw up your data analysis!) in the end. Most important, you need to consider who your primary data users are and what their specific data needs are that must be met. Possible data users include:

- Participants
- Watershed/Lake/River/Landowner Associations
- Volunteer and Elected Decision-makers
- State or Federal Agencies
- Interest Recreational Groups/ Sporting Clubs
- Industry
- Researchers/Educators

To have an agency utilize your data you may need to provide it in a very specific format or even a designated database system. If they are not your primary data user, though, you may elect to utilize your own choice of data management system that works best for your program and develop or obtain tools to upload or "batch" your data from your system to theirs. However, if a single system can meet all of your needs it may be the way to go as less time would be involved in data management.

As you consider the data management systems presented at this conference be sure to evaluate them completely in the context of your specific needs. Learn what they do as well as what they do not do. Do you have or can you obtain what is needed to facilitate the use, adoption and/or conversion to the system? How have other monitoring programs incorporated these systems? What were their (or what might be your) barriers to implementation and can you surmount them?

INTRODUCTION TO DATA MANAGEMENT AND THE STORET APPROACH

The STORET Approach

CONTACT INFORMATION

For more information, contact STORET User Assistance at phone: (800) 424-9067 or e-mail: STORET@epa.gov.

Further information including the name and phone number of EPA Regional Office STORET coordinators is available through the STORET webpage at www.epa.gov/storet

STORET is a national repository for water quality, biological, habitat and physical data of documented quality and is used by state environmental agencies, EPA and other federal agencies, universities, volunteer monitoring organizations, and many others. By organizing your data in STORET, you'll be able to maintain a record of your monitoring efforts while sharing the information you collect with others. State, local, and federal water quality specialists from around the country will use the data in STORET to evaluate water quality conditions, make planning decisions, and generate reports. Volunteer monitoring programs should consider using STORET if they would like their data to be used in this way along with other high quality state, tribal, local, federal and university data.

STORET, which is PC-based and has been modernized from its original mainframe version, requires basic information about your sampling efforts in order to ensure that the data are of documented quality. STORET asks each organization to enter information on how it conducts the business of monitoring, such as who is doing the monitoring and what, where, when, how, and why you are monitoring. Once you have made an initial investment of time in entering these data – essentially customizing your copy of STORET to reflect your monitoring program– data entry is relatively swift.

Data submitted to the EPA STORET warehouse are now available via the internet. With a standard web browser, you can browse the data interactively or create files to be downloaded to your computer.

To enter data into STORET, you need a copy of the CD-ROM with the STORET software (which is available free from EPA), as well as a copy of a commercially available relational database management software package called Oracle. Your organization needs to decide whether it will be more effective for you to host your copy of the database from a single computer or to place it on a shared network to be accessed by more than one user at a time. Some EPA Regions and states are assisting their users in establishing network-based configurations.

Each EPA Region has a STORET coordinator who supports the implementation and use of STORET in that Region. Your Regional coordinator should be able to assist you in getting a copy of STORET and help you get enrolled in a STORET training session. This 2 to 2.5 day course explains how to install, operate and maintain STORET. It also covers accessing STORET data from the STORET Warehouse using a web browser and incorporating the data into commonly used software such as spreadsheets. This course is intended for STORET clients and can be customized to meet specific interests and needs.

STUDY DESIGN: DECIDING WHY, WHAT, HOW, WHEN, AND WHERE TO MONITOR

SESSION INFORMATION:

No individual papers were submitted for this overview and discussion session

Moderators and Presenters:

Geoff Dates
River Watch Program, River Network
6 Poor Farm Road, Hartland, VT 05048
phone and fax: 802/436-2544
email: gdates@rivernetwork.org

Angie Reed
River Watch Program, River Network
RR 4 Box 4250, Houlton, ME 04730
phone: 207/532-4889, fax: 207/532-2480
email: areed@rivernetwork.org

The purpose of this workshop was to help participants make nitty-gritty study design decisions.

Why do a study design?
Because variability happens! Not only that, there are several types of variability:

- Natural variability that is both time & scale dependent (e.g. dissolved oxygen, channel meanders, biological community composition)
- Human-caused variability that is also time & scale dependent (e.g. pollution, hydro-modification)
- Variability caused by sampling & analysis (e.g inconsistent or inaccurate techniques)

Monitoring and assessment is all about understanding these 3 types of variability. However, in order to truly understand them, we would need to measure everything, everywhere, all the time! Since we can't do that, we sample the environment and use these samples to represent the truth we will never know.

A study design is the process by which we make choices in how to sample the environment. We make these choices to maximize the signals we're trying to measure, and minimize the noise from things we aren't.

What Is a Study Design?
Study design is both a *process* you use to make decisions about your monitoring, and a *document* you create that puts your decisions in writing. The process looks like this:

Step 1: What Is Already Known About Your Watershed?

Step 2: Why Are You Monitoring?

Step 3: What Will You Monitor?

Step 4: What Are Your Data Quality Objectives?

Step 5: How Will You Monitor?

Step 6: Where Will You Monitor?

Step 7: When Will You Monitor?

Step 8: What Are Your Quality Assurance Measures?

Step 9: How Will You Manage, Analyze, & Report the Data?

Step 10: What Are the Tasks, and Who Will Do Them?

Within each of these steps are myriad choices. For a description of these choices, see "Developing A Watershed Monitoring Plan" in the proceedings of the 5th National Volunteer Monitoring Conference (EPA#841-R-97-007).