THE
Volunteer Monitor
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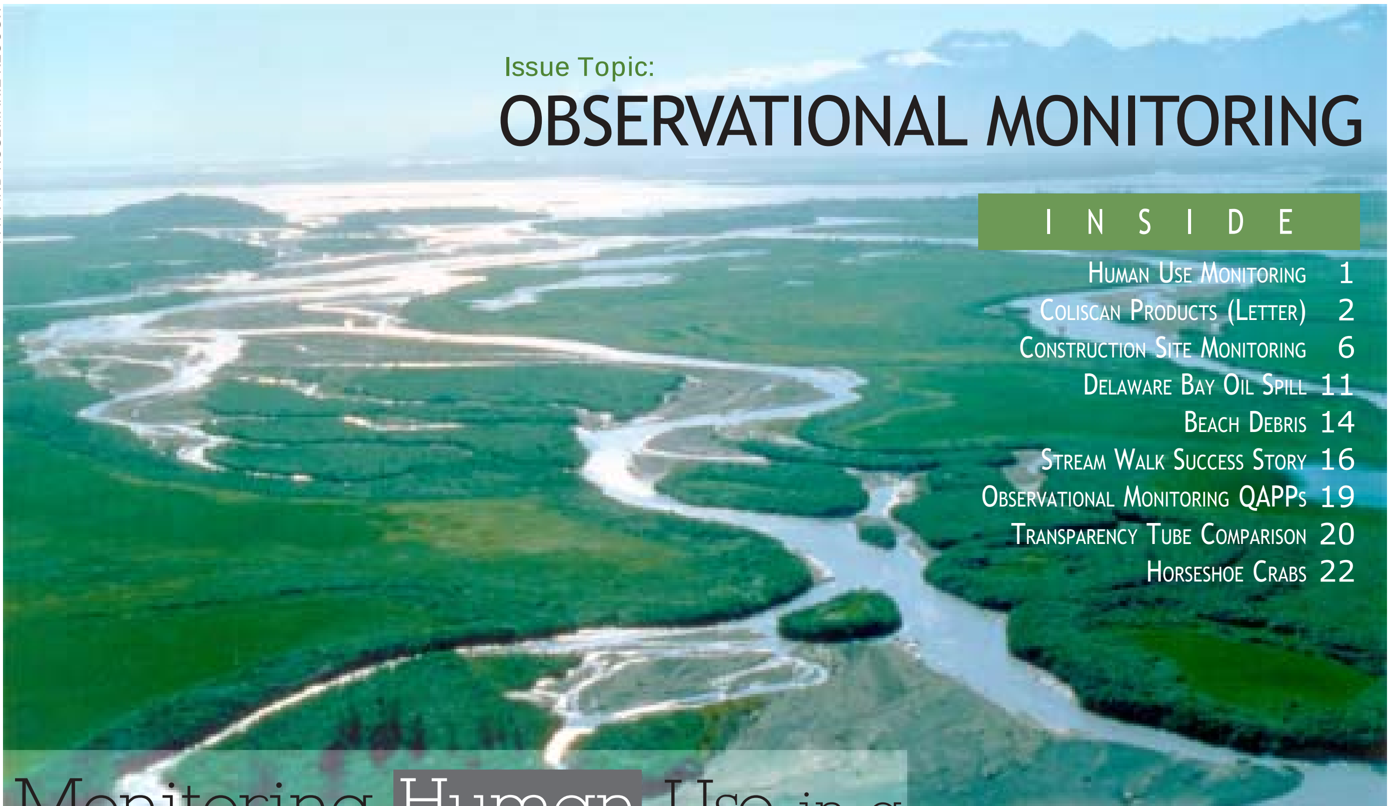

PAT AND ROSEMARIE KEOUGH

INSIDE

Monitoring Human Use in a Remote Alaskan Watershed

by Becky Clausen

When the Copper River Watershed Project's FishWatch planning team met in 2001 to design a fish habitat monitoring project for one of Alaska's most productive watersheds, they knew that underwater data was not the only important indicator. The study design must also monitor what's happening on *top* of the water. So the resource managers and local residents who created FishWatch supplemented the goals of collecting chemical, physical, and biological data with another important goal: monitoring levels of human use. In this way they hoped to detect early signs of salmon habitat degradation caused by concentrated boating and fishing in certain areas.

As the FishWatch Coordinator for the Copper River Watershed Project, I was excited to begin designing this new angle for a volunteer monitoring program. "No problem," I thought, "I'll just research the existing human use programs in the Lower 48 and tailor their protocols to Alaska's needs." Little did I know that human use monitoring wasn't so easy, especially for a region so large and so sparsely populated.

What follows is a summary of how we successfully created a human use monitoring program in a remote Alaskan watershed, and how we managed to sustain it by making the most of our local resources. By including Alaskans who rely on the rivers—from fishing guides to campground hosts—we were able to capture the best data from the most knowledgeable residents.

Above: The Copper River Delta, covering 700,000 acres and spanning 70 miles of coastline, is the largest continuous wetland on the Pacific Coast of North America and one of the world's most productive fish and waterfowl habitats.

A remote & expansive watershed

The Copper River drains a land area of over 26,000 square miles—about the size of West Virginia—inhabited by only 5,600 people. About half the residents live in the one and only incorporated city of Cordova. No stoplights interfere with the flow of traffic in the downtown area, which consists of three blocks of locally owned businesses. Cordova is

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THE
Volunteer Monitor

The Volunteer Monitor is a national newsletter, published twice yearly, that facilitates the exchange of ideas, monitoring methods, and practical advice among volunteer monitoring groups.

Contacting the editor
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Subscriptions & address changes
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***The Volunteer Monitor* online**
The newsletter website, www.epa.gov/owow/volunteer/vm_index.html, contains back issues and a comprehensive subject index of newsletter articles.

Back issues
For print copies of back issues, use the order form on page 23.

Back issues starting with Spring 1993 are available at the website listed above (however, online versions before 2002 don't have the same layout as the printed edition).

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Volunteer Monitoring Listserv

EPA's volunteer monitoring listserv is an open forum for announcements, questions, and discussion. To join, send a blank message to volmonitor-subscribe@lists.epa.gov.

Next Issue Topic: Invasive Species

Monitoring invasive species—plants and animals—will be the theme for the next issue of *The Volunteer Monitor*. We are especially interested in articles with a "how-to" message, which could be related to any aspect of the project (e.g., volunteer recruitment and training, study design, data management, challenges overcome, "data to action"). Please send ideas for articles to the editor (see contact information at left).

Letter to the Editor

Optimizing Results with Coliscan

We at Micrology Laboratories read the Winter 2006 issue featuring bacteria monitoring with great interest as it critiqued the various available methods, including our products Coliscan Easygel and Coliscan MF. Both from reading the newsletter articles and from personal conversations, I have identified several areas where the use of our products might be enhanced or clarified. Also, we have several relatively new products that readers may not be familiar with.

Inversion of plates. Eric O'Brien's article ("Volunteers Conduct Bacteria Methods Comparison Study") mentions that users must wait 40 minutes or more for Coliscan Easygel to solidify before inverting plates and placing them in the incubator. I would like to point out that it is not actually necessary to wait for Easygel to solidify. Plates may be placed in the incubator right side up and allowed to solidify while incubating, as long as the incubator is leveled and the humidity is not high in the chamber. There will generally be no problem with excessive condensate forming on the lids. For best results, stack plates no more than two or three high. If more incubation time is desired after plates are examined at 24 hours' incubation, plates can be inverted at that time.

Room temperature incubation. O'Brien reports unsatisfactory results with Coliscan Easygel incubated at room temperature. Micrology Laboratories has always stated that an incubator provides a much better and more reproducible result than room temperature incubation and has suggested that an inexpensive egg incubator such as the Hovabator (under $50) is well worth the minimal expense. For room temperature incubation, we recommend that users wait until they see some appearance of blue or pink dots (colonies) and then give an additional 24 hours' incubation before attempting to count the colonies.

Sensitivity (detection limit). As noted in the newsletter articles, the maximum sample size that can be used with Coliscan Easygel is 5 ml, which results in a sensitivity of 1 viable *E. coli*/5 ml water sample (20 *E. coli*/100 ml sample). This is more than sensitive enough for most ambient waters. However, we also offer a more concentrated "extra strength" formulation, Coliscan Easygel ES, which allows a 10 ml water sample to be used. This translates to a sensitivity of 10 *E. coli*/100 ml.

Interpreting the results. Since the blue color produced by *E. coli* on Coliscan Easygel can vary from a purple to a dark navy blue depending on the strain of *E. coli*, there can sometimes be questions of "Is that blue enough?" The real question is, "Does that colony produce ß-glucuronidase?" Therefore, Micrology Labs has developed a medium, Coliscan Easygel Plus, that contains two enzyme substrates to test for the enzyme glucuronidase. The plates are read like standard Coliscan Easygel, in that *E. coli* are blue and other coliforms are pink/red, but for verification *E. coli* colonies also fluoresce a blue color when a longwave UV light is shined on the plate.

We also offer Coliscan MF Plus, which is the membrane-filter broth medium containing the additional fluorescent glucuronidase enzyme substrate.

Micrology Laboratories is happy to provide samples of our new modifications of the Coliscan media (Coliscan Easygel ES, Coliscan Easygel Plus, Coliscan MF Plus) to interested parties. Call us at 888-EASYGEL or email jroth@micrologylabs.com. For further information and online ordering, visit www.micrologylabs.com (the "FAQ" link contains detailed information about all the Coliscan products).

Jonathan Roth
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COPPER RIVER, continued from page 1

accessible only by boat or plane; our longest road ends at a glacier 50 miles outside of town.

Twenty smaller communities, ranging in population from 30 to 800, are located throughout the watershed. Most are connected by road to Anchorage—but it's about a five-hour drive, weather permitting.

Salmon: Cornerstone of the economy

Five species of wild Pacific salmon thrive in the delta, tributaries, and lakes of the Copper River watershed. Watershed residents rely on the annual return of the salmon for their economic and cultural well-being. The commercial fishing industry provides over half the employment in Cordova, and in summer the town's population doubles as deckhands and skippers arrive seeking seasonal fishing jobs. At fish processing plants along the water's edge, salmon unloaded from boats are filleted and packed for shipment to global markets that eagerly await the return of Copper River salmon. Throughout the watershed, 80 percent of full-time residents practice subsistence harvest of salmon, along with moose, caribou, and berries, to supplement store-bought groceries.

The Copper River region has acquired a well-earned reputation as a sportfish mecca for king, sockeye, and silver salmon. While small-scale tourism is encouraged to help support local businesses, unbridled visitor recruitment brings with it the potential for damage to salmon habitat. Bank trampling causes erosion and destroys riparian vegetation that serves as a cover from predators. Sediment from the eroding banks suffocates salmon eggs and abrades the gills of juvenile salmon. Hydrocarbons entering the water from outboard engines can cause mortality and deformities to juvenile salmon.

Monitoring salmon habitat

With so much of the local economy depending on salmon, sustaining wild salmon runs and the habitat upon which they depend becomes not only an ecological priority but an economic and cultural imperative as well. In 1997, a group of forward-thinking residents formed the Copper River Watershed Project to encourage a balance between a sustainable regional economy, a healthy ecosystem, and a unique cultural heritage. Four years later, the Project implemented the FishWatch volunteer monitoring program.

Although remarks like "There sure are a lot more people fishing in my favorite streams these days" had been heard around the watershed for years, there was no hard data to back up the perception of increased human use. The FishWatch planning team wanted to collect baseline data on human use to serve as a benchmark against which to monitor changes for years to come. The challenge was figuring out the logistics of monitoring a large, remote watershed with minimal infrastructure or human resources.

Searching for human use models

After two years of working as a U.S. Forest Service fisheries technician on the Copper River Delta, I was eager to be involved in a local initiative focusing on my (wild and expansive) backyard. When I was hired by the Copper River Watershed Project to be the FishWatch Coordinator, Task One was to research existing volunteer monitoring models and create a study design for the Copper River region. I started with the physical and chemical water quality monitoring component, and was overwhelmed by how many successful models there were to choose from. Advice poured in from around the country on the best equipment to use, how to recruit volunteers, tricks on data management, etc. FishWatch would be up and running in no time, I thought, as soon as I figured out how to monitor human use.

I waited for return emails and calls from the various sources that had readily supplied water quality monitoring

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MARK HENSPETER

This scene on the Klutina River during the peak of king salmon fishing season shows why Copper River watershed residents worry about human use impacts. Bank trampling destroys streamside vegetation and compromises streambank stability.

advice. Nothing. I made follow-up calls, and started hearing a familiar reply: "Human use monitoring sounds like a great idea—not sure how to do it though. Get back to us when you come up with something." I traveled from the sociology department of the University of Alaska to the virtual world of many listservs, and still no great leads on how volunteers could provide reliable human use data. No, not a creel survey. No, not a trailhead sign-in sheet. We wanted actual benchmarks of human activity on targeted tributaries during peak season use. How many rafters on the Klutina River, and are they motorized or nonmotorized? How many cars parked at the Mile 18 coho salmon honey hole, and how does the number of fishers vary over time?

Refining the methodology

I asked our FishWatch planning team for advice. We began by reviewing two of our study questions that pertained to human use monitoring:

- What are the current use levels of boaters and fishers on selected streams and lakes in the Copper River watershed?
- What is the amount of increase of boat traffic and fishing effort on selected streams and lakes in the Copper River watershed over a multiple-year timeframe?

In an ideal study design, monitors would address these questions by recording continuous observations of the number of boaters and fishers on the water. Although some paid agency staff do successfully carry out this method of data recording (for example, the Bureau of Land Management erects a temporary counting tower alongside a Copper River tributary and assigns staff to round-the-clock data recording of fish and boats that pass by), it's not reasonable to ask volunteers to stand on a stream bank for long intervals. Another way to obtain statistically significant estimates of current use levels would be to use computer-generated random numbers to assign specific times each day when staff would count boaters and fishers on rivers or lakes. The Forest Service follows this method, randomly assigning an hour of the day when a plane will fly over streams and count the number of boats and fishermen. But asking a volunteer to do a late-night count is a hard sell, even in the land of the "midnight sun."

The planning team realized that we needed to focus our efforts on a practical methodology that provided specific information for our objectives. We decided that it was not necessarily average current use we were interested in; rather, we were most concerned with use at peak intervals—weekends, holidays, and dates that corresponded to the return of king, sockeye, and silver salmon.

Recruiting volunteers

Now that we had narrowed the timeframe of interest, we had to find volunteers. We couldn't simply ask our water quality volunteers to record observations on human use because their sampling sites were not necessarily at locations with heavy human use, and their sampling schedule did not always align with peak human use time periods.

In the true spirit of grassroots initiatives, the members of the FishWatch planning team (many of them longtime residents of the region) began rattling off names of people they knew—neighbors, friends, family members, former employees, local business owners—who lived or worked near the river systems we wanted to monitor, and I scribbled down contact numbers. Although working in an area with a small population presents organizational and infrastructure challenges, the benefits of "everyone knowing everyone" proved to be the strength of our study design.

The benefits of "everyone knowing everyone" proved to be the strength of our study design

Our volunteer pool consisted of approximately 15 people who already had a job, task, or hobby that required them to frequently be on a river segment that was part of our study. Our recruits included two campground hosts, a U.S. Geological Survey gaging station technician, two rafting guides, a fishing guide, and a sportfish charter boat operator. Most everyone we approached readily agreed to fill out a simple form asking for their daily observations on number of boats, type of boat, whether boats were motorized or nonmotorized, and number of fishers. Many offered encouraging comments like "Someone needs to keep track of how many new people are coming here each year."

In Cordova, we formed a rotating pool of volunteers that would take turns driving a certain stretch on the Copper River Highway during peak-use weekends and recording the number of vehicles parked at popular fishing holes. The volunteers enjoyed the excuse to get "out the road" (as we say in Alaska) for glacier viewing and wildlife watching.

I couldn't specify particular times and dates that each volunteer had to be out on the water, but rather allowed the project to be flexible according to each individual's personal schedule. Because of this, we couldn't make statistically

TROY TIRRELL

The 287-mile-long Copper River begins in the Wrangell Mountains, and the watershed is bordered by three mountain ranges.

significant estimates of percent change in use over time. But we gained valuable information on human use at peak time periods (i.e., during waking hours, especially on the weekends) and were able to detect general trends over time.

Five years of FishWatch

FishWatch is now in its fifth year. The human use data has proven to be the most requested information we have collected, and the most useful to resource managers, regional planners, and local residents. It has enabled us to determine which subwatersheds experience the most concentrated use and which are experiencing increases or decreases in human use, and also to identify peak use times as well as sustained use intervals during the summer and fall.

State and federal agencies have incorporated aspects of our data into their own human use studies. For example, Forest Service aerial flight patterns are correlated with where the Copper River Watershed Project has recorded peak vehicle use throughout the silver salmon season. We have agreements with the Bureau of Land Management, U.S. Forest Service, and Alaska Department of Fish and Game to exchange human use data, and we compile data from all these sources into comprehensive reports of human use in our region.

PAT AND ROSEMARIE KEOUGH

Rafters glide past glaciers on the Copper River Delta.

Our program has used the human use data to prioritize subwatersheds for more concentrated and focused human use surveys as well as for possible restoration or remediation efforts. Examples include a river where human use conflicts are beginning to emerge (such as interference between boaters and streamside fishermen) and an area where RV camping near a fishing hole has exceeded the capacity of the waste facility infrastructure. It is our goal that the FishWatch project will raise awareness of these issues *before* they compromise the health of the Copper River wild salmon runs or jeopardize the safety of user groups who enjoy this resource.

I recommend human use monitoring to watershed groups across the country. Human use data highlights the interactions between social systems and ecological systems and shows the connections between human activities and environmental indicators.

Becky Clausen is the FishWatch Coordinator for the Copper River Watershed Project. For more information, please contact her at 907-424-3334 or becky@copperriver.org, or visit www.copperriver.org.

The FishWatch program is funded by Alaska Department of Environmental Conservation, Patagonia, the George H. and Jane A. Mifflin Memorial Fund, and the Mountaineers Foundation.

Report from National Monitoring Conference
Newsletter editor honored

Volunteer monitoring was a strong presence at the 2006 National Water Quality Monitoring Council (NWQMC) conference, held in San Jose last May and attended by about 900 people. Four workshops and nine sessions were entirely devoted to volunteer monitoring, and presentations from volunteer program representatives were integrated into numerous other sessions on a variety of topics.

Adding to the focus on volunteer monitoring was the presentation of the 2006 Elizabeth Jester Fellows award to Eleanor Ely, in recognition of her work as editor of *The Volunteer Monitor* newsletter. As Ely noted in her remarks at the conference, the newsletter's value and usefulness are directly due to the inspiring work of the volunteer monitoring programs featured in its pages.

Nearly 100 people participated in a special meeting for volunteer monitoring coordinators. Topics discussed at the meeting included online data entry, water quality indexes for communicating monitoring results, and liability issues.

Start planning now for the next NWQMC conference, to be held in May 2008 in Philadelphia.

ART GARCEAU

Some of the volunteer monitoring representatives at the conference.

River Rally 2007

River Rally 2007 will be held in the beautiful Columbia River Gorge, Stevenson, Washington, May 18-22. River Rally brings together grassroots organizations, monitors, and other friends of rivers to teach and learn from each other and explore the power of citizen action. Details will be posted in January 2007 at the River Network website, www.rivernetwork.org.

CONSTRUCTION SITE monitoring

by Wendy Steffensen

Three years ago an upset local resident called the North Sound Baykeeper office about a large construction site that was bleeding a lot of sediment into Euclid Creek, turning its waters brown. The creek led to Lake Whatcom, the sole drinking water source for approximately 70,000 people in Whatcom County in northwestern Washington State.

For me, that phone call was a definitive moment. As the North Sound Baykeeper, an educator and advocate for the waters of Northwestern Washington, it is my job not only to advocate for clean water, but also to do something about pollution when it occurs. It became obvious to me that citizens could help address the problem of stormwater pollution from construction sites. Concerned citizens could evaluate construction sites without trespassing, notify officials, and be instrumental in stopping pollution.

In the fall of 2003, I formed the Stormwater Team in cooperation with another local group, People for Lake Whatcom. Our goal was to send trained citizens to construction sites to spot and report stormwater problems. In this way, we could ensure that the eyes and ears needed to assess a multitude of construction sites all over the county would be present through the months and years.

ANDREW CRAIG

Even if a site looks like a muddy mess, it may pose no threat to water quality if it is flat and there are no connections between the site and waterways.

What's the problem with sediment?

At this point you might be asking yourself, as many people do, What's the big deal? Isn't sediment natural? Yes, sediment eroding into streams, lakes, and estuaries is natural. What is unnatural—and polluting—is the accelerated rate at which sediment-laden stormwater is now entering water bodies. This sediment can smother and kill fish eggs. It increases water turbidity, making it difficult for fish to find food. Sediment also introduces phosphorus, a nutrient that promotes growth of algae and plants in enclosed water bodies. For Lake Whatcom, increased sediment translates into more particulates (both algae and sediment particles) in the lake, higher drinking water treatment costs, and a less safe drinking water source. In urban areas, runoff from construction sites accounts for a large proportion of the sediment reaching waterways, sometimes more than 50 percent.

Creating the Stormwater Team

To get help with designing the Stormwater Team program, I held a brainstorming meeting to which I invited the citizen who had made the complaint about Euclid Creek, representatives from People from Lake Whatcom, and stormwater inspectors from state and local agencies (Washington State Department of Ecology, Whatcom County, and the City of Bellingham). We recognized that in order to obtain high-quality information, the Stormwater Team volunteers would need to be familiar with the different measures (commonly referred to as "best management practices" or BMPs) that are used to prevent or control erosion at construction sites.

We decided that the Department of Ecology, in conjunction with county and city stormwater inspectors, would develop a training slide show illustrating the correct and incorrect use of a variety of BMPs. (This slide show, which has been so successful that the Department of Ecology is now using a version of it to train small contractors, can be viewed at www.re-sources.org/baykeeper.htm.) Meanwhile, the North Sound Baykeeper and People for Lake Whatcom would develop protocols and a data sheet for volunteers to use at the sites.

Rating the risk

In addition to determining whether or not an active violation is occurring, Stormwater Team volunteers need to evaluate *potential* risk to water quality. Making accurate judgments about conditions at a construction site can be tricky, as illustrated by the following three examples (based on actual incidents).

Example 1

Heather drives up to a large site during a rainstorm. She is appalled. The entire 2-acre site has been dug up, and there are no BMPs in sight. There is standing muddy water in the rutted ground, and the construction trucks entering and leaving the site are tracking mud onto the roadway. Walking around the site, she observes that it is flat, and the water does not appear to be flowing in any direction. She does not find a storm ditch, storm drain, creek, or any other water body.

Assessment: Heather calls the Stormwater Team Manager, who explains that while the lack of BMPs is disconcerting, the risk to water quality is very low because the site is flat and there is no nearby

Construction Site BMPs

Best management practices (BMPs) for construction sites can be classified into two main types: *source control* and *treatment.* Source control BMPs prevent sediment from leaving the site, mainly by preventing erosion in the first place. Treatment BMPs reduce the amount of sediment leaving the site but do not eliminate it completely.

Source control BMPs

The simplest and most effective method for source control is to leave as much of the natural vegetation in place as possible. Other common source control BMPs are: covering exposed soils with mulch (straw, hay, or bark) or plastic covers; temporary seeding with quick-growing grasses; avoiding construction during the rainy season; and installing silt fences. Because silt fences allow passage of clays, they should be used in conjunction with other source control measures.

Treatment BMPs

Treatment BMPs include drainage swales (ditches designed to trap sediment; often they are lined with rock or filter cloth), dikes, grass-lined channels, straw bales, storm drain filters (these trap debris but allow water and finer sediments to pass through), and temporary sediment ponds.

ANDREW CRAIG

Good source control BMPs. The dirt pile is covered with plastic, and exposed soil is covered with hay mulch.

ANDREW CRAIG

Inadequate BMPs. The dirt pile is uncovered, and in the event of rain the straw bales would not effectively prevent muddy runoff from getting into the storm drain.

water body or storm drain. The only possible risk might be from the mud that is tracked onto the roadways, but that dissipates quickly and there appears to be no mechanism to transport the dirt from the road into a waterway.

Action: The data is recorded, but no further action is taken. The Stormwater Team Manager suggests that the site does not need to be visited again.

Example 2

John passes over a creek on his way uphill to a small construction site. It is the middle of winter—the rainy season in western Washington State. A light rain is falling and the ground is saturated. As John parks his car, he notes that the site looks good: dirt piles are covered with straw or plastic sheeting, and there are silt fences that appear to be anchored in and maintained. Upon walking closer, however, John is astounded to see a trench cut underneath the silt fence, with dirty water running through the trench into a storm ditch. He tracks the ditch to a small tributary that joins other tributaries, eventually leading to Lake Whatcom.

Assessment: John knows that he is seeing a violation of stormwater rules. He immediately calls both a stormwater inspector and the North Sound Baykeeper. The North Sound Baykeeper explains to John that he has witnessed the illegal dewatering of a site. Construction sites often need to be dewatered during the rainy months because the ground becomes too wet for construction to occur. Dewatering is legal, but only if the muddy water is kept out of water bodies.

Actions: The North Sound Baykeeper places formal complaints to stormwater inspectors at both the Department of Ecology and Whatcom County, then goes to the site to take samples. The samples show a clear violation, with turbidity in the stormwater ditch about 20 times greater than in the tributary at a site upstream of the violation. To ensure that the violation is corrected, the North Sound Baykeeper requests a formal report from the stormwater inspectors, documenting that they followed up on the complaint. She also asks John to visit the site again in a week.

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WENDY STEFFENSEN

An illegal trench cut underneath the silt fence is allowing dirty water to run into a storm ditch.

Example 3

Trish is assigned to a new subdivision construction site. Walking in the areas considered public, she notes that there are none of the usual BMPs, but there is a detention pond, filled with murky water. Most of the land has a slight slope. Soil is exposed and has run off with the rain into the streets and storm drains of the subdivision.

Assessment: Trish thinks the whole site is in violation and doesn't know how such a big site can have no BMPs. The North Sound Baykeeper tells her that the site is probably not as bad as it seems. Yes, sediment is getting into the subdivision's storm drains, but those storm drains lead to the detention pond, not to a waterway. However, the contractors are taking chances by not implementing accepted construction stormwater BMPs. Detention ponds are designed to handle post-construction stormwater, not the large amount of sediment that runs off during construction. When there are no BMPs on site, as in this case, water draining to the pond will be full of sediment. If it rains, the pond could overflow and discharge that sediment-laden water into a nearby waterway.

Action: The North Sound Baykeeper reports the site to the Department of Ecology, stating that it has a "substantial potential" to pollute with the next rain.

Learning to evaluate risk

Stormwater Team volunteers acquire the skills they need to make accurate site evaluations through a combination of training and experience. In addition, the Stormwater Team Manager and I are always ready to consult with the volunteers.

Volunteer training takes place in two sessions. At the first session, held on a weekday evening, local stormwater inspectors present the slide show on construction site stormwater BMPs, and then I talk about how to use photographs and the Stormwater Team data sheet to document and report site conditions. The following Saturday morning we make a field visit to nearby construction sites, where volunteers can see and document actual BMPs, determine whether violations are occurring, and assess potential risks to water quality.

Volunteers are trained to consider the following questions to help evaluate the risk of stormwater pollution from construction sites:

1. *Is rain predicted in the near future?*
   If heavy rains are predicted, the risk is higher.
2. *What are the current and recent past rain conditions? Is the ground already saturated?*
   Saturated soil presents a higher risk than non-saturated soil, because any additional rain will likely run off rather than being absorbed.
3. *Are there exposed piles of dirt on the site? How large are they?*
   The greater the amount of exposed soil, the greater the risk of stormwater pollution.
4. *Is the site flat or sloped?*
   The greater the slope of the land, the greater the risk of stormwater pollution.
5. *Are BMPs sufficient to prevent sediment from running off-site with the rain?*
   The evaluation of sufficiency is subjective and takes some experience. The number and type of BMPs present, the maintenance of those BMPs, and the slope of the land must all be taken into account.
6. *If sediment is likely to run off-site, where will it go?*
   This question asks volunteers to think like a water drop. If the water will end up in a water body, the site is higher risk.

FREDA TEPFER

Stormwater Team volunteer Toth Morris inspects a rock swale.

Citizen recruitment

We target recruitment at neighborhood groups in areas experiencing rapid development. Our training sessions (five so far) have each netted between 15 and 30 people. We have found that recruitment is most effective after stormwater and construction problems have been featured in the news. The most reliable volunteers are generally those who make stormwater inspection into a hobby, as many retired volunteers do, or who are preparing themselves for a job in the environmental field.

A day in the life of a Stormwater Team member

A Stormwater Team volunteer is typically responsible for three or four different sites at any given time. The Stormwater Team Manager obtains lists of construction sites from the various jurisdictions and assigns volunteers sites near where they live. Volunteers are encouraged to visit their sites during rainstorms, when it's easiest to determine how well BMPs are functioning and to observe water quality violations.

Staying on public land: The first thing a volunteer must do at the site is to figure out where the public rights-of-way are. Most roads and sidewalks are public, except when they are part of a subdivision that is actively under construction and not yet open to the public. After the general public can enter the area to look at a house for purchase, drive home, or visit a friend, the roads are typically public. If volunteers are told they are trespassing, they should leave the site and report the incident to the Stormwater Team Manager.

Assessing the site: The volunteer walks around the site as much as possible, noting and following the flow of water while still staying on public rights-of-way. By checking the perimeter of the site, our volunteers have discovered cases where muddy water draining off a site was coming from upstream pollution, not the site itself. By following the flow of water, they have discovered instances where muddy water was being illegally drained into a storm ditch that conveyed water into a stream.

Using the Stormwater Team data sheet as a guide, volunteers record observations about site conditions, including what BMPs are being used. The most common cause of stormwater pollution from construction sites is not the absence of BMPs but rather the failure to maintain BMPs. Volunteers need to look carefully to determine whether BMPs are being adequately maintained. Volunteers also use the form to record answers to the risk-evaluation questions discussed above.

Documentation: Inspectors can most quickly respond to a complaint if they have complete information. In addition to filling out the data sheet (including a sketch of the site), volunteers take digital photos, making sure that the time-date stamp is turned on and that they get both close-up and long shots. Good documentation photos provide context: a picture of a stream of muddy water is not meaningful unless it also shows the exposed hillside that the mud is coming from.

WENDY STEFFENSEN

This poorly maintained silt fence is collapsing, allowing sediment to get into a roadside ditch that leads to a creek.

THE MOST COMMON CAUSE OF STORMWATER POLLUTION FROM CONSTRUCTION SITES IS NOT THE ABSENCE OF BMPS BUT RATHER THE FAILURE TO MAINTAIN BMPS

A photograph of a violation, or the potential for a violation, is much more powerful than a written description. Andrew Craig, the Department of Ecology stormwater inspector who was the lead developer of the training slide show, points out that in a photograph violations are essentially "frozen in time." The volunteers' photographs provide inspectors with concrete evidence that a problem occurred, even if the problem is no longer apparent by the time inspectors visit the site.

Interacting with the contractor: Volunteers are instructed not to confront the contractor and to be respectful. Volunteers can and do answer questions when they are approached. Some volunteers choose to visit sites after hours, when the contractor and construction workers are not on-site.

Reporting: Except in the case of a serious problem requiring immediate action, volunteers initially report their findings to the North Sound Baykeeper program. Based on the information that the volunteers provide, we decide whether to (a) send the complaint on to an inspector; (b) keep a watch on the site, inspecting it again in a week's time or after the next rainfall; or (c) move the site to a lower priority. In this way, the North Sound Baykeeper functions as an interface between the volunteers and the government inspectors, ensuring that the correct inspectors get notified and that there is consistency and quality control in the reporting. When volunteers see a blatant water quality violation, they call both the appropriate stormwater inspector (city, county, or Department of Ecology, depending on the location of the site) and the North Sound Baykeeper.

Stormwater Team accomplishments

In 2005, our volunteers made 855 visits to construction sites, which resulted in 104 complaints being filed with state, county, or city stormwater inspectors. Most of these complaints were followed up with visits by stormwater inspectors. Some site operators received verbal or written warnings. In cases where noncompliance was blatant and ongoing, fines were imposed. The Stormwater Team's initial complaint and photo-

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documentation of a site discharging muddy water into a creek resulted in a hefty fine of $108,000 levied against a housing project owner and contractor in July 2006.

The presence of the Stormwater Team has raised the awareness of both local government officials and the public about the problem of stormwater runoff from construction sites. The Team contributes to water quality protection by stopping violations and ensuring that there is better implementation of BMPs. Our credibility with inspectors lies with our systematic method, our camera files, and our database. Without our data, our communication with government officials would not be taken as seriously.

From Andrew Craig's perspective, an important benefit of the Stormwater Team is helping to create a level playing field for contractors. If construction site operators can get away with poor practices, they have a competitive advantage over operators who are spending time and money to protect water quality. Having additional eyes and ears to monitor construction sites helps inspectors target their attention on sites that are not implementing proper BMPs.

IN ORDER TO PROTECT OUR WATERWAYS, IT'S NECESSARY TO MAKE IT MORE EXPENSIVE FOR CONTRACTORS TO TAKE CHANCES WITH WATER QUALITY THAN TO PROTECT IT

The biggest victory for the Stormwater Team has been the abolishment of a scheme called the "point system" in the Lake Whatcom watershed. The point system, a compromise between local government and development interests, allowed construction to take place during the rainy months depending on the number of "points" a construction site had. Points were given for slope, soil type, size, and proximity to a water body.

Dedicated investigation by Stormwater Team volunteers and interns demonstrated that the point system was a dismal failure. Volunteers photodocumented numerous examples of construction sites that were given the go-ahead for construction based on the number of points, but that were contributing massive amounts of sediment into roadside storm ditches that connected via tributaries to Lake Whatcom. The biggest problem was the failure of contractors to maintain their BMPs.

In February 2005 the Stormwater Team released a report written by the Stormwater Manager, detailing and pictorially showing the failures of the point system. Following much public discussion about the information in the report, the County Council voted to overturn the point system and enact a seasonal clearing ban that curtails building activities after September 1.

Challenges

Some of the challenges the Stormwater Team faces are inherent in the nature of construction sites. Because construction sites are transient, it is sometimes difficult to identify a problem, ensure that a stormwater inspector visits, and follow up to see that the violation is addressed within the timeframe of construction at that particular site. Because sites are often bounded by private property, violations and problems are sometimes out of sight of the volunteers, who must stay on public rights-of-way. For example, an entire downhill slope next to a stream may be off-limits, or it may be impossible for volunteers to determine where water draining from a detention pond is going.

Another challenge for us is working within the existing system of government stormwater inspection. This may seem counterintuitive since we work so closely with inspectors, and they help us greatly with training and support. The truth, however, is that while both the North Sound Baykeeper program and the stormwater inspectors want to stop water quality violations, we have different mandates. All the inspectors in the county have a heavy workload and tend to follow a triage approach. Although inspectors always respond to Stormwater Team complaints and are very appreciative of them, they do not always respond to our requests for follow-up actions or visits. Sometimes they let lesser violations go. Very often they choose to educate contractors rather than impose fines.

It is frustrating for us to see stormwater inspectors educating the same contractors again and again at different construction sites, or giving multiple warnings at a site before imposing fines. Sometimes we repeatedly report a site for "substantial potential to pollute," yet the site gets only a cursory educational visit from inspectors. After a few weeks' time, we have to report the same site for an active violation—a violation that could easily have been prevented by earlier intervention. Our view is that many contractors will take shortcuts around protecting water quality as long as it is faster, easier, and cheaper to do so. In order to protect our waterways, it is necessary to make it more expensive for contractors to take chances with water quality than to protect it.

As the North Sound Baykeeper, part of the larger Waterkeeper organization, I believe that we must be firm about protecting water quality and use all available tools, from education to legislation to legal action. Since we have seen that education alone does not work to stop water quality violations, we need to step up enforcement activity, and begin levying heavy fines earlier in the process. This can be done through the system in place now, if stormwater inspectors are given the direction and support from their superiors. It can also happen through changing the law (a slow process) or by organizations like North Sound Baykeeper suing contractors for violating the Clean Water Act.

In order to help prevent water quality violations, we will continue to train volunteers and monitor construction sites. In order to change the system, we are exploring legal and legislative action.

Wendy Steffensen is the North Sound Baykeeper. She may be contacted at 360-733-8307; waters@re-sources.org. For more information, including Stormwater Team data forms and slide show, visit www.re-sources.org/baykeeper.htm.

EMERGENCY RESPONSE on the Fly:
Delaware River Oil Spill

by Faith Zerbe

The Northeast's longest undammed river, the Delaware, flows for 330 miles before finally emptying into Delaware Bay. The bay's natural treasures include the world's largest population of horseshoe crabs—ancient mariners that have spawned on shores since before the age of the dinosaurs. Each year, Delaware Bay hosts North America's second-largest population of migrating shorebirds, who feed on horseshoe crab eggs to nourish their bodies for the long journey ahead.

MAYA VAN ROSSUM

The *Athos I* after the spill.

The Delaware Bay and River also host some not-so-natural visitors: oil tankers that carry 85 percent of the East Coast's supply of oil up the mouth of the river to five ports in the heavily industrialized Philadelphia-Camden area. This high volume of oil being transported makes the river, and the natural life that relies on it, vulnerable to devastating spills.

Such a disaster struck late on Friday, November 26, 2004, the day after Thanksgiving, when the tanker *Athos I* sustained two punctures in its single hull and leaked an estimated 265,000 gallons of heavy Venezuelan crude oil into the Delaware River near Paulsboro, New Jersey, about two miles south of Philadelphia city limits. Within three days, Delaware Riverkeeper Network had begun deploying citizen volunteers to observe and report on the spill and the cleanup efforts—and our staff had acquired a few more gray hairs from working around the clock to get our monitoring effort up and running.

Monitors needed

The morning after the oil spill, Delaware Riverkeeper Maya van Rossum visited the site of the spill and attended meetings and press conferences. "Two things quickly became apparent," she says. "The damage to the river was immense, and there were not enough eyes and ears out assessing that damage." Knowing she would need on-the-ground reconnaissance information from many locations to help her better advocate for the river during the emergency, van Rossum called on Delaware Riverkeeper Network's 15-year-old volunteer monitoring program to recruit and coordinate volunteers. (Delaware Riverkeeper Network is a nonprofit advocacy organization headed by the Delaware Riverkeeper.)

Tributaries at risk

Delaware Riverkeeper Network saw a clear need for getting volunteers out to monitor tributary streams. The official response was primarily focused on the river's main stem, which was where the spill had occurred. But because the spill was in the tidal portion of the river, there was imminent danger of incoming tides moving oil up into tributaries, even those that were upstream of the spill. We wanted to know which tributaries were being hit and how far up tributaries the oil was moving. We wanted to make sure that containment and sorbent booms were placed at the mouths of tributaries. We wanted to find out if booms had become dislodged or submerged, allowing oil to pass over or around them, and we wanted to be able to quickly alert Coast Guard cleanup crews to any problems, so that the injury to the river and tributaries could be minimized.

> Because the spill was in the tidal portion of the river, there was imminent danger of incoming tides moving oil up into tributaries.

Gearing up for action

Unlike our other monitoring work, the *Athos I* spill was a situation where we were mainly mobilizing new volunteers who had never been to a Delaware Riverkeeper Network training or workshop. That said, the people who did step up to volunteer were very familiar with the tributary streams, since many recreated on or lived by the river and had an affinity for it. Our phones were ringing off the hook with people offering help. Tri-State Bird Rescue and Research (the organization responsible for cleaning and caring for wildlife injured in the spill) could only use their own specially trained volunteers, so we invited them to refer others to our organization. We felt it was a great opportunity to engage these concerned citizens in monitoring at a critical time, but we also knew that our protocols would need to be straightforward and simple since there would be no opportunity for in-person training.

Since we did not have existing data sheets or protocols specifically designed for oil spill assessment by volunteer monitors, Delaware Riverkeeper Network scientists quickly created a data sheet and accompanying instructions and posted them on our website for volunteers to download. The data sheet was geared mainly toward collecting information to help the emergency cleanup effort. It asked about the location of oil impacts, the nature of the impact (e.g., sheen, oil on water surface, oil stains on beach, oiled debris, oiled wildlife,

continued on next page

OIL SPILL, continued

tarballs, etc.), and the presence and condition of booms.

About a week into the spill, we posted two additional data forms for our volunteer monitors. One was a "Wildlife Injury Assessment Form" provided by the U.S. Fish and Wildlife Service. The other, called "Quick Oil Spill Site Assessment," was a somewhat simplified version of the data sheet used by agency officials to collect information for use in the Natural Resources Damage Assessment (NRDA) process. We developed this form because the coordinator of New Jersey Department of Environmental Protection's (NJ DEP) Volunteer Monitoring Program reached out to us, requesting that our data be shared with NRDA officials. The form called for specific types of information that are useful in quantifying the damage to natural resources and determining the cost of restoration. For example, volunteers recorded the types of habitat that were damaged and an estimate of the amount of oiling for each habitat type.

All the monitoring our volunteers did was observational; they made no measurements and collected no samples. For the Quick Oil Spill Site Assessment, volunteers referred to diagrams on the form to help them classify the degree of oiling on shorelines as "sporadic," "patchy," "broken," or "continuous."

The spill extended as far north as the Tacony-Palmyra Bridge in Philadelphia, and tarballs were found as far south as Cape Henlopen.

Eyes on the water

When people called to volunteer, we assigned them a specific tributary based on where they lived. We asked them to assess their tributary as often as possible and at different tidal stages, starting at the mouth and working their way upstream as far as the stream was tidally influenced. Volunteers made observations from public access points such as roads. For some southern tributaries that were less developed, volunteers used boats to gain access. Even though we didn't offer face-to-face training, as Monitoring Coordinator I communicated personally by phone or email with most of the volunteers to make sure they understood the task and stayed safe.

If volunteers saw a situation (such as a malfunctioning boom) that required urgent attention from Coast Guard cleanup crews, they immediately contacted Delaware Riverkeeper Network. We sent an emergency fax to the Coast Guard, and the Delaware Riverkeeper followed up by phone. Volunteers then made field visits to make sure that the problem was addressed. If volunteers observed oiled or injured wildlife they contacted the wildlife hotline number provided by the agencies.

During the first month of the spill, observations from a volunteer team of 90 citizens enabled Delaware Riverkeeper Network to alert cleanup crews to 30 instances requiring immediate action (e.g., malfunctioning booms, or tarballs or oiled debris coming onto shore). Our volunteers also noted, unfortunately, tributaries that never received boom protection but were oiled by the incoming tide. All told, we received monitoring reports for 27 tributary streams, 4 beaches, 3 wetland habitats, and 16 inland water areas where volunteers were assigned to look for oiled birds that had been able to escape the immediate area of the spill. Most of these reports were accompanied by photographs and detailed maps, increasing the credibility of the volunteers' observations.

Lessons and advice

Looking back at the *Athos I* spill and the events that unfolded, we have some points to share to help other monitoring programs respond to similar emergencies.

Plan for emergencies

Delaware Riverkeeper Network staff crammed everything from developing volunteer data sheets and posting them on the Web to recruiting and coordinating volunteers into just 56 hours. While we are proud that we pulled all this off successfully, having protocols and trained volunteers at the ready would certainly have been far less stressful.

It's also a good idea to communicate with emergency response officials before a crisis occurs and let them know that your organization will mobilize volunteers in the event of an emergency. This will help ensure that you are kept in the loop during the emergency, and will save time on coordination.

One size doesn't fit all

As days passed and the oil moved downstream with the tide, tarballs—black, hard balls of weathered oil mixed with debris and gravel—began showing up along beaches. However, our data forms were more oriented toward tributary impacts and weren't well suited for capturing detailed information about tarballs on beaches. We plan to expand our protocols to add more guidance for beach and wetland monitoring.

Negative findings are valuable

When we called some volunteers who hadn't submitted reports, we learned that they had recorded observations but never sent in their data sheets because they hadn't observed any oil impacts. We realized that we needed to emphasize to volunteers that reports of "no oiling" are just as important.

FAITH ZERBE

Absorbent and containment booms in place across Raccoon Creek, near the mouth.

Give data a voice and an active role

Delaware Riverkeeper Network, as an advocacy organization, has a commitment and responsibility to use the monitoring data it collects to speak out for the river. Making our data actively work for the resource is mandated for all of our monitoring efforts.

In the first few weeks after the spill, the Delaware Riverkeeper had the attention of the press and local radio and television news stations. Our volunteers' data enabled her to provide reporters with better information about the status of cleanup operations, the extent of the spill, and the scope of the damage.

A report summarizing the volunteers' data was submitted to NRDA officials. In addition, van Rossum has used the data in testimony to Congress, at public hearings, and in meetings with NRDA officials.

Where we are now

The damage assessment process is still ongoing, and preliminary lists of restoration projects to help mitigate damage from the spill are being developed. NRDA officials have solicited our input on these projects, and the Delaware Riverkeeper continues to work with the press to highlight the spill's long-term impacts and the NRDA process. The oil inflicted damage on more than 100 miles of tributary and mainstem shorelines. Costs for cleanup operations have totaled over $175 million, of which $50 million was paid through the Oil Spill Liability Trust Fund and the remainder by the party responsible for the spill, Tsakos Shipping.

> Delaware Riverkeeper Network has a commitment and responsibility to use the monitoring data it collects to speak out for the river.

The Coast Guard has included the Delaware Riverkeeper Network's monitoring component as part of the Emergency Response Plan for the river. We have also begun working with NJ DEP's Volunteer Monitoring Program to expand our *Athos I* protocols into emergency response guidelines that can be used by other New Jersey monitoring groups.

Almost immediately after the spill, the Delaware Riverkeeper began calling for legislation prohibiting single-hulled tankers like the *Athos I* from entering the Delaware River. (Double-hulled vessels have a second shell to help prevent a spill in case the first shell is damaged.) In July of this year, a step in this direction was taken when the state legislature passed a bill doubling fines for spills from single-hulled vessels.

Was it worth it?

The Delaware Riverkeeper Network monitoring program "runs lean" to begin with, and responding to the *Athos I* disaster meant putting some of our current commitments on hold. But the ability to switch gears and react quickly to a significant threat was critical to fulfilling our role of protecting the river, and the effort we put forth benefited both the river and our organization. The next time an oil spill threatens the Delaware River, we will mobilize again—but this time we will be better prepared, and our monitoring will be integrated into the cleanup operations and NRDA process from the start.

Faith Zerbe is Monitoring Director for Delaware Riverkeeper Network, headquartered in Bristol, PA. She may be contacted at 215-369-1188; faith@delawareriverkeeper.org. For more on Delaware Riverkeeper Network's response to the *Athos I* spill, including copies of the assessment sheets used by the volunteers, visit www.delawareriverkeeper.org.

Pointing to Debris Sources and Solutions

by Eleanor Ely

September 20, 1986, Texas: 2,800 volunteers descend on Texas Gulf Coast beaches for a beach cleanup that's more than a cleanup—it's one of the first efforts to get quantitative data about debris on the beach. The volunteers are carrying not just plastic bags to fill with debris, but data cards on which they record their tally of the items picked up.

September 16, 2006, Worldwide: Hundreds of thousands of volunteers in nearly 100 different countries participate in the International Coastal Cleanup on beaches, lake shores, and river banks. Like their 1986 forerunners, they record information about the debris items on a data card.

A direct line connects these two events. The cleanup has been continuously run by the same organization, the Ocean Conservancy (formerly called the Center for Marine Conservation). Yet the organizers of the 1986 cleanup could not have dreamed of the changes 20 years would bring—not just the astonishing expansion to areas surrounding every major water body on the planet, but also the evolution in how debris is tabulated and how the results are interpreted and used for abatement.

Taking a closer look at the data cards used in the two events, we notice that the 1986 card is divided into six categories, each of which is a material—plastic, glass, Styrofoam, metal, paper, wood. Under each category is a list of specific items, such as bags, bottles, light bulbs, wire, fishing nets, and many more. The 2006 card, by contrast, classifies the debris items according to the activity that is the most likely source of that particular type of debris. Thus, under the category "Shoreline and Recreational Activities" we find beverage bottles, utensils, and food wrappers, among others. "Ocean/Waterway Activities" includes such items as bait containers, buoys, fishing line, fishing nets, and rope.

This change in data card design is more significant than it might at first appear. Behind it lies a rather fundamental shift in philosophy.

Early focus: Plastic in the ocean

The 1986 cleanup was motivated in large part by concern about ocean dumping of plastics. Amid growing awareness that marine animals were getting tangled up in discarded plastic and ingesting plastic articles that they mistook for food, environmental organizations were pressuring the U.S. Congress to ratify Annex V of the International Convention for the Prevention of Pollution by Ships (MARPOL 73/78), banning the disposal of plastics anywhere at sea as well as ocean dumping of other forms of trash within defined distances from shore.

The Texas event inspired many other states to organize similar cleanups using the same data card. Data from 1986 and 1987 were used in a petition to Congress supporting MARPOL, which the U.S. ratified in 1987 and put into effect the following year. In 1988 the Center for Marine Conservation received data from beach cleanups in 25 U.S. states and territories. They all reported that plastic items and pieces were the most prevalent type of debris.


THE OCEAN CONSERVANCY

International Coastal Cleanup volunteers in Korea turn in their completed data cards.

New directions

During the 1990s, the thinking about beach debris evolved. First, it became increasingly clear that on most beaches the great majority of debris items came from activities on land, not ocean dumping. Some of this land-based debris was deposited directly on the beach by beachgoers. Other items came from farther inland and were carried oceanward by winds and rivers, often first traveling out to sea before later washing up on beaches.

Meanwhile, the organizers of the cleanup—now a worldwide event—were recognizing some limitations in the way the debris was being tallied. One problem was that the data card listed "pieces" as a type of debris item under the various types of materials (plastic, glass, etc.). Year after year the number one item found in cleanups was "plastic pieces."

Seba Sheavly, who coordinated the International Coastal Cleanup (ICC) from 1994 to 2005, says, "We realized that the approach of categorizing by material and counting pieces wasn't giving us enough information. To work effectively toward solutions, we needed to know more about debris sources so we

LLOYD DEGRANE

ICC participants tally debris at Chicago's Rainbow Beach on the shores of Lake Michigan.

could focus on the behaviors and activities that produce debris."

So Sheavly and others set about redesigning the data card and instructions. Volunteers would continue to pick up all debris, including pieces, but they would tally and record only recognizable items. On the new data card, the materials-based classification system was replaced by five new categories representing different debris-producing activities. These included the "Shoreline and Recreational Activities" and "Ocean/Waterway Activities" categories mentioned above, plus "Smoking-Related Activities," "Dumping Activities," and "Medical/Personal Hygiene."

Sometimes it was obvious which category an item belonged in. Fishing lines and nets are clearly associated with ocean activities, while picnic items such as plates and utensils are indicators of shoreline activities. Other cases required more analysis. For example, beverage cans were placed under "Shoreline and Recreational Activities." "You might argue that beverage cans could come from boats," says Sheavly. "But we have found that when aluminum cans are dumped at sea they tend to sink. So most of the cans you find on beaches are from land."

The new card was introduced for the 2001 ICC and has been used, with slight modifications, ever since.

Another change during the 1990s was the expansion of the ICC to include inland waters, and even underwater sites surveyed by divers.

Changing behavior

"The true value of the ICC is the actions that are taken as a result," says Sheavly. "The goal is to change behavior. This is the real success."

Behavior change can come about on many levels, starting with the individual. Sheavly says, "When you pick up trash and tally it, you're holding it, you're seeing it, you're registering it. You begin to realize that every single piece of debris has a person's face behind it. If you're really honest with yourself, you can probably identify some of your own actions that could lead to debris on the beach."

Change can also occur on the local and state level. In response to what's found in cleanups on local beaches, municipalities may take actions ranging from placing trash receptacles in specific locations, to starting a recycling program, to sponsoring a campaign to discourage smokers from using the beach as an ashtray.

Each year, the Ocean Conservancy (TOC) produces individual summary reports for every participating state and country. The information helps states and countries identify which activities are causing the greatest problems and decide where to target efforts at abatement.

At the national and even international level, information from the ICC is used to support policies and programs for preventing and reducing debris—for example, programs to reduce the amount of derelict fishing gear in the ocean.

Corporations can also change their behavior, and Sheavly is a strong believer in working with, not against, industries that contribute to the debris problem. One of her favorite stories concerns ITW-HiCone, the world's primary producer of plastic six-pack rings. Sheavly says, "Remember, six-pack rings were one of the early 'poster children' of the marine debris issue, with photos of seals and birds entangled in the rings widely used in publicity campaigns. If any industry was going to not want to participate in a campaign because it pointed to them as part of the problem, this would be it." Instead, the industry was proactive, developing a photodegradable six-

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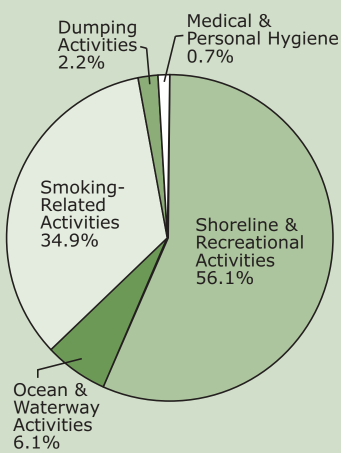
United States: 2005 ICC Data

Sources of Debris



Top Ten Debris Items

	Percent of Total
1. Cigarettes	31.4%
2. Food wrappers	11.1%
3. Caps and lids	9.5%
4. Cups, plates, and utensils	6.0%
5. Plastic beverage bottles	5.8%
6. Glass beverage bottles	5.0%
7. Beverage cans	4.6%
8. Straws and stirrers	4.2%
9. Bags	4.1%
10. Cigar tips	1.7%
	83.4%

Adapted from TOC 2005 ICC Summary Report

From Stream Walks to Stream Restoration: Data to Action in the Real World

by Jane Brawerman

In an ideal world, problems noted by Connecticut River Watch Program stream walk volunteers would be followed up on right away by our staff here at the Connecticut River Coastal Conservation District. Potential pollution sources would be field-checked and prioritized for restoration, and from there we would work with local and state officials to ensure that problems were corrected. Sound good? Well actually, those of us working in the trenches know that getting from data to action is rarely that straightforward. Limited resources and competing demands often derail our best intentions. And if it were that simple, this story about how stream walks led to the creation of a demonstration streambank buffer wouldn't be quite as interesting.


VIVIAN FELTEN

Students from Berlin High School help with mulching.

Our first stream walk

The Connecticut River Watch Program, our Conservation District's citizen monitoring program for the Connecticut River and tributaries, was initiated in 1992. Early on, monitoring activities focused on water sampling and macroinvertebrate surveys, primarily in the Mattabesset River watershed. When volunteers embarked on the program's first stream walk survey in 1998, one goal was to locate specific impairments that could help us determine where the bacteria, nutrients, and suspended sediments documented in our seven years of Mattabesset River water quality studies might be coming from. We also wanted to obtain baseline information on instream and streambank conditions and adjacent land uses.

Our volunteers used a slightly modified version of a stream walk protocol developed by the Connecticut Natural Resources Conservation Service (NRCS), which consists almost entirely of visual observations (see sidebar on page 18). Volunteers were trained in an indoor-outdoor workshop at which they signed up for predefined stream segments one-half to one mile in length. The District provided them with survey forms printed on waterproof paper, color topographic maps of their stream segment, an instruction manual, and materials to help them identify aquatic vegetation.

Over the next couple of months, the volunteers walked 23 segments in tributary streams where we had previously collected water quality data. They worked mainly in teams of two, spending about two hours per half mile of stream. Slogging through streams and getting a glimpse of what goes on in the backyards of residential areas was eye-opening. Volunteers came back energized from their firsthand learning experience about stream ecology and the human activities that can be harmful to streams. Their newfound perspective was an extremely gratifying outcome of our maiden stream walk survey.

What the volunteers found

The survey data gave us numerous valuable clues about possible sources of water quality impairments in the streams. Volunteers found such problems as unstable, eroding banks; lawns maintained to the stream edge; excessive algae growth; discharge pipes; yard waste dumped on the bank or in the stream; and silt and sand blanketing the stream bottom. There was clearly a lot of work to be done to improve streams in the watershed—not the least of which was to help streamside landowners be better stewards of their backyard water resources.

District staff compiled and summarized the stream walk data in a report, and later the information from the report made its way into the *Management Plan for the Mattabesset River Watershed*, a blueprint for restoring the river to fishable and swimmable conditions.

Buffers can be beautiful

So—how did we get to the demonstration stream buffer project from here? Well, fast forward to 2001. Ruth Klue, a new staff member at our "sister" Conservation District to the north, studied the management plan and was particularly excited by one of its recommendations: to "target outreach and education to streamside property owners about the importance of maintaining and restoring riparian buffers." Klue, who has a degree in landscape design, recalls thinking, "Here's a task that fits my own strengths." She decided that a demonstration project showcasing the attractiveness of vegetated buffers would be an ideal way to encourage homeowners to plant streamside vegetation. "People are unlikely to do anything if it's like taking your medicine," says Klue. "I wanted to create a model to show people that a vegetated streamside buffer in their backyard could actually be an enhancement, something that would be inspiring to live with as well as beneficial to the environment."

The first step was to choose a location for the project. And it was at this point that the two efforts came together. Klue spoke with Vivian Felten, an ecological landscaping specialist with NRCS, who remembered the Connecticut River Watch Program stream walk data. When Klue and Felten reviewed our data, they were excited to see that the volunteers had not only recorded estimated widths for riparian vegetation but also keyed the information to their topo maps.

"I WANTED TO SHOW PEOPLE THAT A VEGETATED STREAMSIDE BUFFER COULD BE INSPIRING TO LIVE WITH AS WELL AS BENEFICIAL TO THE ENVIRONMENT"

"We thought, 'This would be much easier if all the data was on the same map,'" says Felten. So Felten enlisted the help of an NRCS cartographer, who used an aerial photograph as a base and then created another layer (using GIS software) on which she drew color-coded lines corresponding to the volunteers' buffer-width data. Now Klue and Felten could see at a glance where there were residential areas that needed better buffers. After field-checking various potential sites, getting advice from the Mattabesset River Watershed Association, and consulting with individual property owners, they selected a site on Hatchery Brook in the town of Berlin.

The site consisted mainly of a 150-foot-long strip of town-owned floodplain parallel to the stream. There were four backyards abutting the publicly owned strip, with no fences or other visual distinctions to mark property lines. The private property owners had been mowing the town-owned strip along with the backyards, creating a single large lawn running right to the edge of the brook. Neither the town nor the adjacent property owners were completely satisfied with the arrangement, especially because the floodplain area was often very wet and difficult to mow.

Neighbors join in

Klue and Felten hoped the property owners would want to include portions of their backyards in the buffer project, so they held several neighborhood meetings to talk about the project design and goals. They explained their vision of planting native, inundation-tolerant trees, shrubs, ferns, tall grasses, and flowering perennials to create dense vegetated areas. Grassy footpaths meandering around the planted areas would invite strolling and provide access to the stream. The stream would benefit because runoff from the vegetated buffer would contain less fertilizer, pesticides, and sediment than runoff from the lawn, and the trees and shrubs would help prevent erosion by holding the streambanks in place. The buffer would also create habitat and a corridor for wildlife.

Four families were intrigued by the proposed project and wanted the buffer to extend onto their property. According to Klue,"Some were inspired by the idea of creating gardens in their yards, some by environmental concerns, and others by the frustration of dealing with their mucky lawns." The final plan, designed with input from the participating neighbors, covered half an acre.

RUTH KLUE

Flowering perennials flourish one year after planting. The sparsely vegetated area at left has been planted with ferns and shrubs that will take some time to fill in. The grassy path leads down to the stream.

Lots of work, lots of helpers

This first phase of the restoration project was completed in fall 2004 with funding from the New England Grassroots Environmental Fund and a Clean Water Act Section 319 grant and assistance from many local people. Volunteers from Aetna participating in our local United Way "Day of Caring" removed a wild tangle of prickly invasive plants. Town of Berlin staff rototilled the lawn area to prepare for planting, disposed of invasive plants, provided wood chips, and dredged a silted drainage outlet. The adjacent property owners, members of the local Kensington Garden Club, and teen volunteers from Berlin High School planted and mulched.

Klue says that if she were to do it again, she would try to get even more advance commitments of assistance from local groups. Her advice for others installing vegetative buffers: "Don't underestimate the work, especially of spreading mulch." Felten adds, "Mulching seemed unending and burned volunteers out." What's more, mulch needs to be renewed annually for the first few years, until the plants get established.

It's rewarding to have a tangible on-the-ground result of our stream walks in the Mattabesset River watershed, especially one that can be used as an example for other residential stream restoration projects. Klue has created a brochure based on the project that explains the benefits of buffers and provides tips on designing and creating them.

Other stream walk spin-offs

We also use our stream walk findings in a number of other ways, some of which may not be quite as obvious and visible as the buffer project. Because the data were used in developing the Mattabesset River watershed management plan that we are now working to implement, information from the survey informs and underlies many of our activities.

We've tackled landowner education by developing a backyard stream guide

continued on next page

STREAM WALK, continued

promoting practices to protect streams, which was mailed to all streamside landowners in the watershed. We continue to work with municipalities to reduce sediment input to streams through improved stormwater management and erosion and sedimentation controls. And just this summer, we embarked on a "Track Down Survey" focused specifically on identifying and prioritizing restoration opportunities in streams that have been walked by our dedicated River Watch Program volunteers.

Who knows? With a little patience and perseverance (make that a lot!), and the contributions of many others in the watershed community, we just might achieve that ambitious fishable and swimmable restoration goal for the Mattabesset River set forth in the management plan . . .

Jane Brawerman is the Executive Director of the Connecticut River Coastal Conservation District and coordinates the Connecticut River Watch Program for the District. She may be contacted at 860-346-3282; jane-brawerman@ct.nacdnet.org; or visit www.conservect.org/ctrivercoastal/riverwatch/ for more information about the program.

Stream Walking in Connecticut

The stream walk surveys conducted by Connecticut River Watch Program volunteers are closely based on a protocol originally developed in 1996 by Javier Cruz, then a Resource Conservationist with the Natural Resources Conservation Service in Connecticut. At the time, state and federal agencies, citizen groups, and town officials working together in the Norwalk River watershed wanted more information about specific impairments. "We knew about the water quality—we had plenty of water quality data," says Cruz. "Now we wanted to find out where we could go and fix things." The idea of having volunteers conduct surveys to look for problems was suggested, and Cruz was asked to coordinate the project.

Cruz studied a number of existing stream assessment protocols, some designed for agency professionals and others for volunteers, and found them too technical or too long for his purposes. So he took bits and pieces from the different protocols and created a very simple stream survey based on visual observations and estimates. Cruz avoided technical terminology as much as possible and constructed most questions in a "multiple-choice" type of format that offered different options for volunteers to check off. For example, the survey form provided three choices—"everywhere," "in spots," and "absent"—to characterize the prevalence of algae; choices for the visual appearance of the algae included "floating," "matted on substrate," "hairy," and "scum."

Between August and November 1996, about 50 volunteers used the survey form to assess approximately 20 miles of the main stem of the Norwalk River and 16 miles of tributary streams. The volunteers filled out a separate form for each stream segment, or reach, within their assigned section (usually about one mile). They were instructed to define a new stream segment whenever they encountered a major, consistent change in one or more stream characteristics such as slope, width, depth, substrate material, or streamside vegetation.

"Eye-opening" results

The Norwalk River watershed volunteers found a total of 132 impaired sites. The most common problems were impoundments (many caused by homeowners building small dams to create ponds) and lack of riparian vegetation.

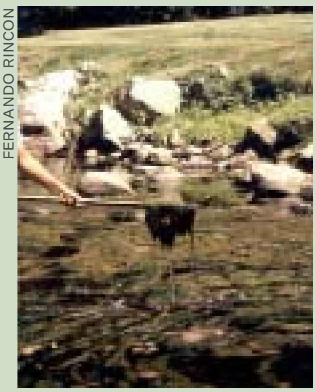
"The findings were eye-opening," recalls Cruz. "I don't think anyone realized how many small dams and pools there were. When we mapped them all out, it got people's attention. Also, I think people had been underestimating the impact of lawns on streams." The photo shows the combined effects of a small (18-inch-high) stone dam creating a pond, and a large lawn running to the water's edge. This area is in a Norwalk River tributary whose watershed has no farms, no industry, and no sewage treatment plant.

Since that first survey, about 15 other watershed groups in Connecticut have used the stream walk protocol, which over the years has been made even simpler and shorter. For example, the original version required volunteers to fill out a lengthy separate form for any site that showed impairments. Cruz says, "After a while, we realized that when there's a problem all we really want to know is, where is it and what's wrong." So the long questionnaire was replaced by a single sheet labeled "Areas of Concern," with large spaces for recording descriptions of potential problems.

Focus on finding problems

Some of the stream walk survey questions are designed to provide a general description of the stream segment—is it steep and

FERNANDO RINCON



Thick mats of algal growth resulting from ponding and lawn runoff.

narrow or flat and wide; what's the approximate composition of substrate materials—but the majority serve to draw the volunteers' attention to possible problems, including channelization, dams, oil slicks, turbidity, fish barriers, excessive growth of aquatic plants or algae, sedimentation, and lack of vegetation on banks or in the riparian zone. The form also asks specifically about the presence of such potential pollution sources as discharge pipes, lawns and gardens, roads, parking lots, farms, and dumpsters. When all the survey sheets are tabulated and mapped, the result essentially amounts to what Cruz calls "a to-do list for improving the stream."

Noting that it's easy to get distracted out on a stream, Cruz says that an important function of the survey questions is "to force the volunteers to look at everything—the canopy cover, the banks, the stream bottom composition." He says some people have asked him, "Why can't we just ask volunteers to write it down whenever they see something wrong?" His reply is, "How will they see it if they're not looking?"

The CT NRCS stream walk survey forms and guidebook may be downloaded from www.ct.nrcs.usda.gov/programs/communities/streamwalk_initiative.html.

Writing a QA Plan for Observational Monitoring

by Eleanor Ely

Writing a quality assurance project plan (QAPP), complete with the 24 elements laid out in the Environmental Protection Agency's (EPA) guidance documents, is a chore not generally approached with great enthusiasm. The job is even harder when the QA plan applies to an observational monitoring project, because EPA's QAPP template was designed for traditional monitoring projects that collect and analyze quantitative data. Even in EPA's guidance document for volunteer monitoring programs (U.S. EPA, 1996), the helpful examples accompanying each QAPP element are mostly based on chemical water quality monitoring.

If your project consists entirely of collecting observational data, it is not immediately obvious how to address, for example, QAPP Element 7, "Data Quality Objectives," which includes data precision, accuracy, representativeness, comparability, and completeness. Equally baffling is Element 11, "Sampling Methods Requirements," under which a traditional water quality monitoring project would put information about sample containers, preservation methods, holding times, and the like.

Two people who successfully cleared all the hurdles involved in writing a QAPP for observational monitoring by volunteers are Seth Lerman, a Resource Conservationist with the Natural Resources Conservation Service, and Faith Zerbe, Monitoring Director for Delaware Riverkeeper Network. Lerman wrote a QAPP for conducting stream walk surveys following the Connecticut Natural Resources Conservation Service protocols described on page 18, which was approved in 1999 by both the Connecticut Department of Environmental Protection and EPA Region 1. Zerbe's QAPP for visual assessment of a local creek by Delaware Riverkeeper Network volunteers was approved by the New Jersey Department of Environmental Protection in 2006. Both Lerman and Zerbe needed to write the QAPPs as a prerequisite for receiving funding under Clean Water Act Section 319.

So, how did they do it? It took creativity and some leaps of imagination. Lerman (whose QAPP went through five revisions in the process of reponding to all the reviewers' comments) says, "Figuring out how this nonconventional data-gathering process fit into the conventional model was an exercise of fitting a round peg into a square hole." One "conceptual breakthrough" for Lerman was realizing that there were places in the QAPP where it was possible to talk about project goals and benefits beyond the actual data. Under Element 5, "Problem Definition/Background," Lerman defined "an environmentally undereducated citizenry" as part of the problem that the monitoring project was designed to address.

IT'S NECESSARY TO "TRANSLATE" THE QAPP LANGUAGE TO FIT THE REALITIES OF OBSERVATIONAL MONITORING

It helps to remember that you don't necessarily have to include all 24 elements in your QAPP. Both Lerman and Zerbe were able to dispense with certain elements with a simple statement like "not applicable to observational monitoring."

Sometimes it's necessary to "translate" the QAPP language to make it fit the realities of observational monitoring. For example, take Element 12, "Sample Handling." For this element, EPA's volunteer monitoring QAPP guidance suggests including things like the type of information that will be put on the sample bottle labels, or the procedures that will be used for tracking chain of custody. Lerman, however, chose to treat the stream walk data sheet itself as the "sample." This allowed him respond to Element 12 by talking about how the program handles the survey sheets—i.e., how volunteers return their sheets to the program office and how the data is entered into the computer database. Similarly, under Element 11, "Sampling Methods Requirements," instead of talking about containers, preservation methods, or holding times, Lerman included information on how survey segments would be delineated by volunteers in the field.

Comparing Lerman's and Zerbe's QAPPs shows that there is some arbitrariness concerning what information is put under which element. Elements 7, "Data Quality Objectives," and 14, "Quality Control Requirements," are among the more challenging elements for observational monitoring. Zerbe addressed Element 7 with a detailed discussion of specific steps that would be taken to maximize data consistency and comparability (such as volunteer training and staff review of volunteer data sheets). Lerman, on the other hand, called Element 7 "not applicable"—but then under Element 14 he included many of the points that Zerbe talked about under Element 7.

Is the struggle worthwhile? Lerman says yes, although he thinks the process could be made even more useful if EPA would develop a modified QAPP template specifically for qualitative assessments. Writing the QAPP, he says, helped standardize and strengthen the stream walk process, giving it greater credibility and validity. Zerbe agrees, noting that an approved QAPP gives your data more "teeth," so if volunteers find a problem, "there should be no excuse made that the volunteers were not trained or credible." Lerman's advice: "Work collaboratively—everybody has ideas and insights that can be helpful. And don't get frustrated."

To obtain copies of the two QAPPs discussed above, contact Seth Lerman, 860-871-4065, seth.lerman@ct.usda.gov, and Faith Zerbe, 215-369-1188, faith@delawareriverkeeper.org.

Resource

U.S. EPA. 1996. *The Volunteer Monitor's Guide to Quality Assurance Project Plans.* U.S. EPA Office of Wetlands, Oceans and Watersheds, Washington, DC. EPA 800-B-96-003. Available online at www.epa.gov/volunteer/qappcovr.htm.

Comparison Study: HORIZONTAL & VERTICAL Transparency Tubes

JOHN SHALLES

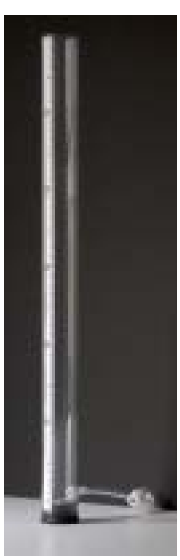
Bob Carlson demonstrates the New Zealand clarity tube. A magnetic aquarium cleaner is used to slide the target back and forth.

by Robert E. Carlson

In a letter in the Summer 2004 issue of this newsletter ("Horizontal clarity methods from New Zealand"), Rob Davies-Colley of New Zealand's National Institute of Water and Atmospheric Research (NIWA) described a horizontally held "clarity tube" used by volunteer monitors in New Zealand to measure water clarity in streams. The horizontal tube was inspired by another horizontal water clarity measurement used in New Zealand since 1989: the black disk method (Davies-Colley, 1988), in which a matte black target mounted on a stick is viewed horizontally underwater through an inverted periscope.

The clarity tube makes ingenious use of a modified magnetic aquarium cleaner. An all-black target is attached to the inside magnet of the cleaner. The observer moves the target back and forth using the outside magnet, or slider.

Volunteer programs in the Unied States use vertically held tubes based on the "turbidity tube" (now usually called a transparency tube) originally developed in Australia (see *The Volunteer Monitor* Fall 1994 and Winter 2004). The tube has a target painted on the bottom—a pattern of wavy lines in the Australian model, and a miniature black-and-white Secchi disk in most U.S. models. The observer looks down through the open top of the tube while lowering the water level until the target becomes visible. The original design required that water be poured out; later versions have an outlet tube at the bottom for releasing the water.



H. VINCENT LAWRENCE

The vertical transparency tube used in the study.

At the May 2004 National Water Quality Monitoring Council meeting in Chattanooga, Mike Scarsbrook of NIWA was kind enough to give me a New Zealand clarity tube. Although Kilroy and Biggs had reported (2002) that the horizontal clarity tube produces values similar to the horizontal black disk, I was not aware of any investigations comparing measurements made with the New Zealand tube to those made with the vertical transparency tube, and I was interested in performing such a study.

During the summers of 2004 and 2005, my students and I did side-by-side comparisons of the New Zealand tube and vertical transparency tube in tributaries and main bodies of Delaware and Chesapeake Bays in conjunction with a remote sensing survey conducted by the Cooperative Institute for Coastal and Estuarine Environmental Technology. The sites represented a wide range of water clarity, dissolved color, and chlorophyll concentrations.

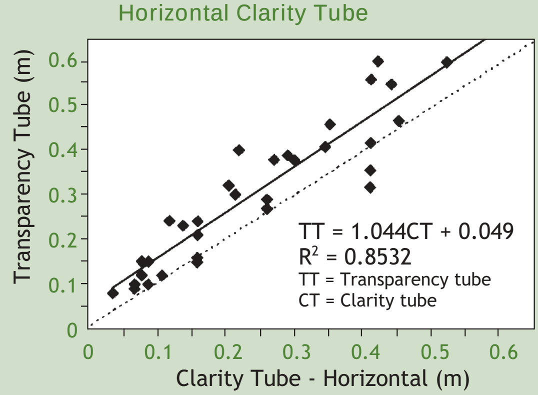
The transparency tube we used (donated by Water Monitoring Equipment and Supply) is 60 cm long with a miniature black-and-white Secchi disk target attached to the bottom stopper (see photo, below left). The New Zealand clarity tube is 1 m long and has a matte black target attached to a magnetic slider, as described above.

Comparing the two tubes

When we compared the two tubes using the same water sample, the vertical transparency tube produced significantly different (and higher) transparency readings than the New Zealand horizontal clarity tube (Figure 1). However, the slope for the relationship was not significantly different from 1, indicating that the two instruments are measuring the same aspects of water clarity.

The difference in the readings could be due to inherent differences in the manner in which light is attenuated in the horizontal and vertical orientations, as suggested by Davies-Colley, or it could be due to the differences in the design and structure of the tubes or targets.

Figure 1. Vertical Transparency Tube vs. Horizontal Clarity Tube

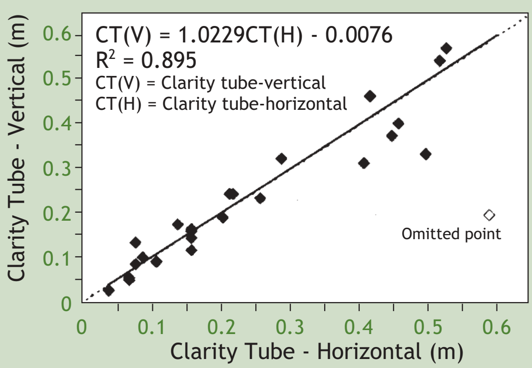


Does orientation matter?

To test the first hypothesis, we took transparency readings with the New Zealand clarity tube held both vertically and in the recommended horizontal position. As shown in Figure 2, when one outlying point was omitted, the slope of the relationship was not significantly different from 1 and the intercept not significantly different from zero. In other words, the results were the same whether the tube was held horizontally or vertically.

An explanation for the similarity of the readings may be that light enters at all points along the clear tube, whether vertical or horizontal, thus eliminating any orientation effect.

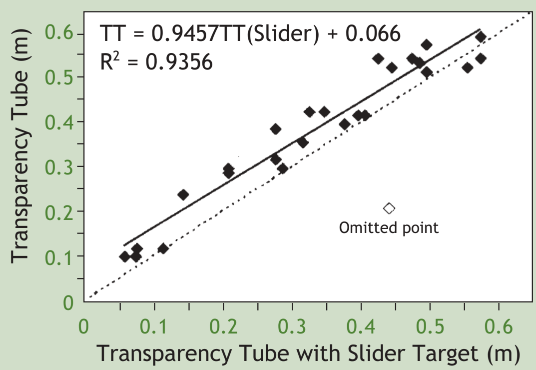
Figure 2. Clarity Tube: Vertical vs. Horizontal



Using slider target in transparency tube

We then created a sort of hybrid tube by using the magnetic slider with the black target in the vertical transparency tube. Comparing the hybrid tube to the normal transparency tube, we found that the two instruments gave parallel results, but the values with the normal transparency tube were slightly higher (Figure 3). Apparently putting the black slider target into the transparency tube caused the transparency tube to behave like the clarity tube (see Figure 1). This suggests that the differences in readings seen in the first experiment mainly result from differences in the two targets, rather than other design differences between the tubes (such as tube length, diameter, or material).

Figure 3. Transparency Tube with Normal Target vs. Slider Target



Practical implications

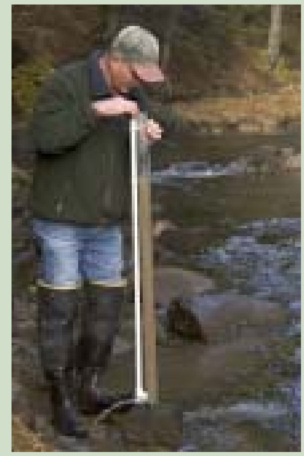
The reason the two targets give different readings requires further investigation, but our results imply that tube orientation is unimportant and that the clarity tube could be held vertically. A vertical tube with the magnetic slider target might be the best of all worlds, combining the advantages of a movable target with the advantages of a vertical orientation.

We found the magnetic slider target to be a distinct improvement over the stationary target on the bottom of the transparency tube. It allows the user to repeat the reading several times without needing to refill the tube, and to watch the target both disappear and reappear (as is done when reading a Secchi disk). The slider is also much easier to manipulate than the various methods for draining water from vertical transparency tubes, and it avoids making a messy puddle on the ground or in the boat.

A vertical tube is more practical for a single operator because the horizontal clarity tube is hard to hold steady without a second person to support the distal end. Another advantage of a vertical tube is that it allows the user to look directly at the water surface, while a horizontal tube requires looking through a window (since the end of the tube must be closed). The viewing window makes the horizontal tube more expensive to produce, and the user needs to protect the window from scratches or other damage.

Tube with Extension Handle

This extra-long, 120-cm transparency tube has an extension handle which allows the operator to release water without having to reach to the bottom of the tube. Available from www.watermonitoringequip.com; 207-276-5746.



H. VINCENT LAWRENCE

We are not suggesting that every program using transparency tubes switch to using a magnetic slider target, because the readings will be different. Switching might be considered if extensive cross-calibration shows a consistent relationship between the old and new targets in all types of water conditions. However, programs that are initiating transparency measurement should seriously consider using the slider.

References

Davies-Colley, R. 1988. Measuring water clarity with a black disk. *Limnology and Oceanography* 33:616-623.

Kilroy, C. and B.J.F. Biggs. 2002. Use of the SHMAK clarity tube for measuring water clarity: Comparison with the black disk method. *New Zealand Journal of Marine and Freshwater Research* 36:519-527.

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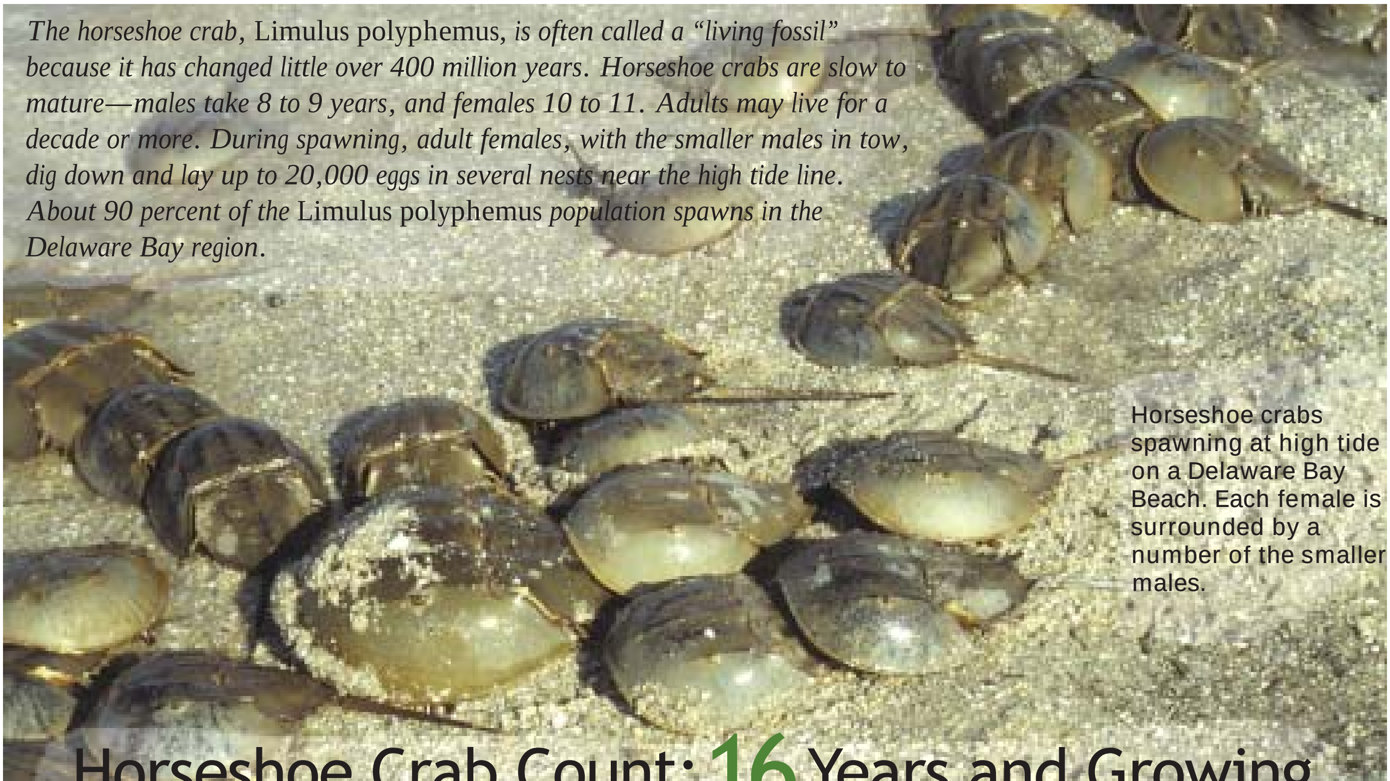
Horseshoe Crab Count: 16 Years and Growing

The horseshoe crab, Limulus polyphemus, *is often called a "living fossil" because it has changed little over 400 million years. Horseshoe crabs are slow to mature—males take 8 to 9 years, and females 10 to 11. Adults may live for a decade or more. During spawning, adult females, with the smaller males in tow, dig down and lay up to 20,000 eggs in several nests near the high tide line. About 90 percent of the* Limulus polyphemus *population spawns in the Delaware Bay region.*



Horseshoe crabs spawning at high tide on a Delaware Bay Beach. Each female is surrounded by a number of the smaller males.

DELAWARE SEA GRANT

by Bill Hall

Horseshoe crabs donate a lot of blood to medical science. Their blood cells, or amoebocytes, are used in testing the safety of products that cross a cell membrane—for example, surgical implants and injectable drugs. That's because even after such products are sterilized to kill all bacteria, harmful substances called endotoxins, which are part of the cell membrane of many common bacteria, may still be present. As it happens, horseshoe crab amoebocytes are extremely sensitive to bacterial endotoxins. A $100-million industry is based on testing medical products with the Limulus Amoebocyte Lysate (LAL) test.

Delaware Bay is the epicenter of the horseshoe crab population, with hundreds of thousands of adults appearing each spring to spawn on Delaware and New Jersey beaches. It is also the center of the commercial fishery for horseshoe crabs, which are used to bait traps, especially for eel and conch. This bait fishery is currently the greatest threat to the horseshoe crab population.

The census begins

Concern about the potential for overharvesting of the "golden goose" of the pharmaceutical industry led Jim Finn, a retired pharmacological researcher, to think about using volunteers to monitor the horseshoe crab population in Delaware Bay. Horseshoe crabs are one of nature's curiosities in that they return each spring to spawn at the water's edge on estuary beaches. Mass spawning occurs in May and June at the high tides around the new and full moons (i.e., the highest tides of the month). Every year, one date will be the peak of spawning activity. Counting the spawning animals on the peak date is the easiest and least expensive way to track population changes.

In 1990, Finn gathered together a few interested people—Carl Shuster, an adjunct professor at the Virginia Institute of Marine Science; Benjie Lynn Swan of Limuli Labs, a biomedical company that uses Delaware Bay horseshoe crab blood for the LAL test; and myself—to help plan and launch a volunteer horseshoe crab spawning survey. It is notable that the initiation of this survey had no financial support from federal or state natural resource managers or from industry, but rather was born out of a perceived need and commitment by researchers.

Although none of us knew much about designing a spawning census, we came up with a crude but workable protocol. We decided to conduct the survey on the day we predicted should be the peak spawning date based on the moon cycles. At both high tides on the selected day, the volunteers would count male and female crabs in 10-m linear stretches, at up to 10 different locations on each beach. Distinguishing males from females is easy because generally the females are considerably larger. In case of doubt, volunteers simply flip the crab over and look for the male's distinctive "thumb," used for hooking onto the female.

A total of 35 Delaware Bay beaches, 13 in New Jersey and 22 in Delaware, were monitored on the chosen date of June 8, 1990. This proved to be quite an undertaking, especially since there could be hundreds of actively moving crabs in one 10-m sample area. Over the next decade, we tried some modifications, including changing the size of the area counted. However, we continued to conduct the survey on a single date. This was a weak point, since the exact date of peak spawning activity varies depending on weather conditions. Sometimes we hit it and sometimes we missed it. But

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we didn't have enough resources to expand the survey to cover more dates.

Revising the protocol

In the mid-1990s, the Audubon Society and other birding organizations became alarmed about the number of horseshoe crabs being taken for bait. Delaware Bay hosts the largest shorebird migration in the Lower 48, and the migrating birds depend heavily on horseshoe crab eggs as a food source. Audubon put pressure on the Atlantic States Marine Fisheries Commission, which in turn put pressure on the mid-Atlantic states to study the status of the horseshoe crab population, create management plans, and impose harvest limits. Ours was the only current study, so the states looked to our numbers. They also offered funding and support to help make the survey more rigorous.

In 1998, a meeting was held of all the interested parties, including the U.S. Geological Survey, to develop a protocol that would give the most meaningful data for fisheries managers to use in regulation. We came up with a revised protocol that has been consistently used since 1999. It calls for taking many more samples—100 per beach—but the sample size is smaller, just 1 square meter. Volunteers place a 1-m frame at randomly selected intervals along the high tide line, then count all the animals in the frame. Counts are done only at the second high tide of the day since our data showed that counts for the morning high tide were consistently lower.

Most important, we expanded the survey to a total of 12 days. In both May and June, we conduct a series of three surveys around each new and full moon. One survey takes place two days before the date of the new or full moon, another the day of, and a third two days after.

We needed more volunteers and more coordination, so we evolved from assigning individual volunteers to a beach to having government or nonprofit organizations sponsor a beach. Each organization is responsible for mobilizing its own volunteer teams to cover all the survey dates. Sponsoring groups also do most of the training.

We have kept the protocols simple. The greatest challenge comes from the need to match the survey time to the peak spawning time. On some nights, high tide may be at 2 a.m. on certain beaches. If so, that's when the survey takes place. Volunteers begin their counts just as the high tide begins to ebb (recede), and must work quickly to complete the survey within 40 minutes, before the tide goes out too far.

Why we continue to monitor

We have 150 to 200 volunteers each year. The volunteers come back because they can readily see the fruits of their efforts. Our counts are the most important data used in setting annual harvest quotas for the horseshoe crab bait fishery in the mid-Atlantic states. Currently the limit in Delaware Bay is 300,000 (half in Delaware and half in New Jersey), as compared to the estimated harvest of over 1 million per year in 1990. We know the harvest regulations have had an effect because the number of juveniles seen in state agency trawls has increased dramatically over the last few years.

It just doesn't get any better or more real than that for a volunteer program.

Bill Hall is a Marine Education Specialist with University of Delaware Sea Grant Program. He may be reached at bhall@udel.edu; 302-645-4253. For more information, including survey protocols, see www.ocean.udel.edu/public/volunteer.html.

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BEACH DEBRIS, from page 15

pack ring in 1989, before it was required by the EPA. The company also initiated a program to collect and recycle used six-pack rings (see www.ringleader.com).

Over the years, plastics manufacturers, beverage and tobacco companies, and other industries have supported the ICC in many ways, including contributing financially to the cleanup itself and to numerous education and pollution-abatement campaigns, involving their employees as volunteers in cleanups, and even having representatives sit on TOC's Board of Directors.

NMDMP: More rigorous

The ICC has been tremendously successful, but there is no way that a data collection effort spanning the globe and involving hundreds of thousands of people can collect rigorously standardized data. So, in the early 1990s, TOC in collaboration with a multiagency federal workgroup including EPA and the National Ocean and Atmospheric Administration (NOAA) began developing and field-testing a sampling protocol that became the National Marine Debris Monitoring Program (NMDMP, pronounced "num-dump"). NMDMP was designed to yield statistically valid data that could be used to determine marine debris status and trends.

NMDMP's designers carefully analyzed the data from ICC cleanups in the United States and selected 30 key items to use as indicators for the NMDMP study. (Note that these items are specific for the U.S.; a similar program in another country would need to analyze its own marine debris data to identify appropriate indicator items.) They divided the nation into nine regions, based on ocean currents, and in each region they randomly selected 20 beach sites for inclusion in the study.

By 2002, NMDMP was fully implemented nationwide by TOC under Sheavly's direction. This marked the beginning of an intensive national five-year data-collection effort that will run through May 2007. Volunteers monitor their assigned beach every 28 days, following carefully defined protocols. Survey Directors conduct quarterly quality-control procedures to verify that volunteers are counting and identifying items correctly and are not missing any items on the beach.

Analysis of the data from this extraordinary volunteer effort, the first attempt to collect scientifically valid data about marine debris nationwide, should yield some very interesting new information about patterns of marine debris in different regions and trends over time.

For more information, contact NMDMP Program Director Seba Sheavly, 757-321-2606, seba@sheavlyconsultants.com, or ICC Coordinator Sonya Besteiro, 202-429-5609, sbesteiro@oceanconservancy.org; or visit www.oceanconservancy.org.

THE OCEAN CONSERVANCY

NMDMP volunteers follow a specific walking pattern to ensure that the entire site is covered.