The Volunteer Monitor

The National Newsletter of Volunteer Water Quality Monitoring
Volume 11, No. 1, Spring 1999

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Issue Topic: Restoration

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The following articles appear in this edition of *The Volunteer Monitor*
(not all graphs and figures available)

Rotating co-editors

The Volunteer Monitor has a permanent editor and volunteer editorial board. In addition, a different monitoring group serves as coeditor for each issue.

This issue was coedited by the Delaware Riverkeeper Network, which works to protect the Delaware River watershed through advocacy, monitoring, enforcement, and restoration. The Watershed includes parts of Delaware, New Jersey, New York, and Pennsylvania.

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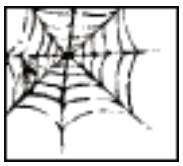

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As we go to press, we are pleased to announce that a new structure for The Volunteer Monitor has just been finalized. River Network, a national watershed protection and advocacy organization, will be producing the newsletter under a Cooperative Agreement with EPA. Eleanor Ely will continue as editor, and the editorial board will remain the same. Look for more details about this exciting development in the next issue. Effective immediately, all inquiries about subscriptions and back issue orders should be directed to:

River Network
The Volunteer Monitor Newsletter
520 SW 6th Ave, Suite 1130
Portland, OR 97204-1535

Next issue

The Fall 1999 issue will focus on youth, featuring both school projects and out-of-school activities (Scouts, 4-H, youth-at-risk, etc.) To contribute an article, please contact the editor.

From the Editor

With this issue, *The Volunteer Monitor* broadens its scope to encompass a new topic: restoration.

Monitoring and restoration go hand in hand. When monitoring reveals a problem,

volunteer monitors naturally want to do something about it. Sometimes a restoration project is part of the solution.

But fixing nature is never simple. You can stabilize an eroding streambank--but will the bank fail again in heavy winter storms? You can pull up invasive nonnative plants and plant natives--but will the new plants hold their own against returning weeds? Only long-term monitoring can answer these questions.

So restoration and monitoring are inextricably linked--or, at least, they ought to be. In reality, monitoring has often been more of a missing link (as Donna Meyers points out in Volunteers Add "Missing Piece"--Monitoring Restoration). There is a huge need for volunteers to collect monitoring data, both before and after a restoration project.

Volunteers are actively restoring all kinds of ecosystems. This issue contains reports on a number of projects, but still barely scratches the surface. Look for continuing coverage of this important topic in future issues.

About *The Volunteer Monitor*

The Volunteer Monitor newsletter facilitates the exchange of ideas, monitoring methods, and practical advice among volunteer environmental monitoring groups across the nation.

The Volunteer Monitor is published twice yearly. The newsletter is also available online at http://www.epa.gov/owow/volunteer/vm_index.html.

Reprinting material from *The Volunteer Monitor* is encouraged. Please notify the editor of your intentions, and send us a copy of your final publication.

Address all correspondence to: Eleanor Ely, Editor; ellieely@aol.com.

Watershed Academy

Watershed Academy, a project of EPA's Office of Wetlands, Oceans, and Watersheds (OWOW), offers a number of programs to assist watershed managers. Among them are:

Training courses: About 20 watershed training workshops, developed by OWOW, on technical/scientific topics, watershed management, and community outreach.

"Academy 2000": Online training modules for distance-learning.

"Inventory of Watershed Training Courses": A national directory of watershed-related training courses, with one-page summaries of 180 courses offered by a variety of federal and state agencies as well as the private sector.

For more information on these and other Watershed Academy activities, visit www.epa.gov/OWOW/watershed/wacademy/. Printed copies of the Inventory are also available at no charge from NSCEP at 800-490-9198 (ask for publication number EPA 841-D-98-001).

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Ecological Restoration: Rebuilding Nature

by John W. Munro

Ecological restoration is different.

Different from what? Different from almost everything we humans have tried to do to fix degraded landscapes and waterscapes.

Different how? Different in that it is about returning the landscape back to an earlier time prior to the damages that have been inflicted. Different in that it has more guiding principles than the likes of concrete-levee construction, wetland mitigation, slope stabilization, and many other land and water "fixes." Different in that those guiding principles not only provide direction to the restoration process, but also provide more ways of monitoring the results to judge whether the intended condition has been achieved.

Ecological appropriateness

The difference lies in *ecological appropriateness.*

When stabilizing a stream in Alabama, is it appropriate to use willows native to Europe? When you restore fisheries and boating to an algae-covered, nutrient-loaded lake, is it wise to adopt a plan to regularly apply broad-spectrum aquatic herbicides? To replant a formerly diverse swamp forest destroyed by a contamination cleanup, is it OK to

uniformly plant with cattails because they are wetland plants?

The site manager might answer yes to all these questions, but the restoration ecologist would have to answer no. The reason: ecological appropriateness.

The way that we determine ecological appropriateness is to reconstruct what plants, animals, hydrology, water characteristics, substrates, and so on were present prior to the disruption of the system. In some ways the restoration ecologist is a "forensic ecologist"- a detective of ecosystem history.

Defining restoration

"Restoration" has become a new buzzword with perceived magical qualities. One hears the term thrown about loosely and often without much thought. Yet the word by itself means nothing.

Seventh-graders from Radnor Middle School plant native wetland shrubs along a pond edge. The banks have been covered with matting made from natural coconut fiber, which will help prevent erosion while the plants become established.

If I am to restore my house, I could restore its function by adding insulation to its walls; I could restore its exterior trim color by painting it white (as it was 20 years ago) or blue (as it was 40 years ago); I could restore its original 18th-century lighting by removing all the wiring and light fixtures. All these activities are restoration but all have different aims, some of which conflict with others.

When we modify the word "restoration" with the word "ecological," a lot of the questions about the meaning of restoration are answered. The technical definition for ecological restoration is:

The process of intentionally altering a site to establish a defined, indigenous, historic ecosystem. The goal of this process is to emulate the structure, function, diversity, and dynamics of the specified ecosystem.

Yes, we all know that perfection is not possible by our own hands and that to rebuild a lost native landscape involves compromises. The American chestnut cannot be re-introduced to forests until and unless the blight is brought under control. The zebra mussel and lamprey inhabit such huge expanses of water that they may be permanent invaders.

This does not, however, prevent restoring past thriving ecosystem conditions in many

places that have been degraded. It merely means that we have to look at the definition carefully and follow the intent of what is stated.

The basic "rules" for ecological restoration come from the definition. The natural world is our model. The end product-the restored landscape-should be self-sustaining with the minimum amount of maintenance possible. When a site is restored it then is subject to natural processes and natural changes and will not likely remain static.

Ecological restoration is a dynamic process that includes science, art, philosophy, people, economics, time, and lofty goals. These elements can be difficult to merge. Yet they are the elements that can begin to reverse the massive trend toward reduction of planetary diversity.

Restoring a stream, ecologically

The ecological restorationist must view the landscape as it is and as it could have been, both at the same time. While observing the degraded conditions of present reality, he or she must overlay a mental picture of what possible repairs can be done (all the while keeping in mind the inevitable limitations of money, time, available labor, etc.). This multiple simultaneous view is part of seeing the complexity of an ecological system.

Volunteers install coconut coir matting on a recontoured streambank at Pennypack Creek in Fairmount Park, Philadelphia.

As an example of how ecological restoration is different, consider the case of a small stream that runs through suburban housing tracts. The course of the stream has been altered to fit lot lines, and as the streambed tries to return to its original shape, it causes erosion of the straightened banks. Meanwhile, the former wooded landscape has been covered with paving, houses, and lawns with soils much more compacted than the original forest soils. During storms, water rushes through in great short surges that dwindle to a trickle after the storm. Mowing of the streambanks keeps them unstable, and weed trimming has removed the deep-rooted sedges that used to hold the stream edges in place. The overhanging trees are gone and now the water temperature is too warm to support some kinds of fish.

The folks in the houses along the banks look at this landscape and see a basically natural stream that perhaps needs to be restocked with fish. The township engineer sees an embankment problem that needs structural repair. The practitioner of ecological restoration sees a drastically impoverished ecosystem and a whole lot of work ahead if

the stream is to be returned to its former water quality and stability.

Why the difference in perspective? Because the restoration ecologist understands in detail how profoundly this degraded stream, now little more than a drainage ditch, has changed from its natural state.

The ecologist sees the silted-in rocks on the stream bottom and knows they can't provide habitat for diverse insect larvae. He or she realizes that fertilizer from the pampered streamside lawns will make algae in the stream grow miraculously fast, choking out submerged plants and many aquatic animals. The ecologist knows that restoring the streamside vegetation will require research to learn what species lived there before-and that those species probably can't be purchased at the local garden supply store but will have to be found in the wild and propagated.

Further, the ecological restorationist recognizes that returning this stream back to ecological health will entail doing things outside of the stream itself, like planting vegetated buffer strips along the stream, or perhaps providing sub-surface groundwater recharge systems in place of standard stormwater basins.

Using natural materials

Often stream restoration requires recontouring scoured vertical banks into slopes that will support plant growth. In the past, "hard" structures such as rock, concrete, and rock gabions (steel-mesh baskets filled with rocks) have been considered "standard." However, such structures are not permanent, and they have many negative ecological effects.

Now it is possible to use natural materials, including coconut fiber fabrics along with native plants. Some placement of rocks may be necessary, but we can use native stone and design the placement to replicate natural patterns in the area. The concept of "natural bioengineering," in which native plants and natural materials are used to repair unstable settings, relies on understanding the engineering properties and capacities of plants. There is almost always a range of possible ways to repair damage to ecological systems. In ecological restoration the choice should always lean toward natural and native.

Restoration model

Every ecological restoration project needs a restoration model-a detailed written statement that clearly outlines the project's goals and acknowledges any limitations. A good restoration model is indispensable because ecological restoration is new. Published methods and guidelines are still in the formative phase.

If you set out to build a house, you can follow the course of many before you. The craft of designing and building houses has developed over many years; materials and methods are relatively standardized.

But when we do ecological restoration work, precedents and off-the-shelf designs are not available. We must ask a lot of questions about the condition of the existing landscape, the possible design choices, the construction and planting process, the materials to be used, the reasons for choices that are made, and the way in which we will test to see if and how the restored system works. The answers to all these questions become the basis for the restoration model.

The restoration model should include:

Restoration Workshops

Eagle Hill Field Seminars in Ecological Restoration are professional-level workshops, 2 to 4 days in length, on topics such as bioengineering, salt marsh restoration, and salvage of plant communities. Workshops are held in various locations around the country. For a complete listing contact Humboldt Field Research Institute, P.O. Box 9, Steuben, ME 04680-0009; 207-546-2821; humboldt@nemaine.com; or visit http://maine.maine.edu/~eaglhill/.

1. Project definition. Why is the project being done? What is it expected to accomplish? Who will provide the driving force?

2. Project area description (ownership, size, shape of waterway, adjacent land cover, etc.).

3. Statement of intent. An example might be the intent to use only locally native species and only natural materials.

4. Sources of information for historic conditions reference-for example, fieldwork, published and unpublished data, management practices of original people, old photos, old people's memories.

5. Statement of the selected time period and conditions that are being emulated.

6. Exceptions and qualifications-for example, conditions that are desired but not attainable.

7. Methods for testing project success. The more detailed and specific the monitoring plan, the more we can learn about how well the projected outcomes are fulfilled in reality.

Avoid planting weeds

Since most restoration is done in highly degraded areas, it's tempting to take the quick-and-dirty approach of using "miracle plants"-fast-growing exotics and cultivars that have been brought in for everything from providing wildlife cover to streambank stabilization to beautification. The list of plants imported for such uses has nearly completely turned into the list of the continent's most vigorous weeds in the wild. Amur honeysuckle, autumn olive, multiflora rose, and many others were all introduced to quickly solve problems. The new problems they have created are much greater than the initial problems they were imported to solve.

History has taught us that planting nonnatives in wild areas really amounts to planting weeds. It's time to abandon the "quick-fix" approach and start investing in ecologically proven native plant communities that have thrived on the land for millennia.

Was the restoration successful?

Monitoring is absolutely essential to ecological restoration work. To see why, let's go back to the house analogy. When you build a house you are not often faced with questions like, Will it work? Will it have value as a house? or even, Will it really be a house? You know it will because house-building is a well-established process. Not so with ecological restoration. Each new project is in a real sense an experiment, another opportunity to learn what works and what doesn't-but only if we do followup monitoring, and not just for the short run, but over a period of years.

Monitoring plans for ecological restoration projects will not follow a standardized format. Each project's restoration model provides the yardstick by which to measure its success. If the model was carefully thought out, the project will be easily checked because the means for checking it are already built in.

Within the model are a number of testable items. The following list is suggestive but not all-inclusive:

- Planting specifications and densities - Were plants placed per specifications?
- Grading plans - Was the earthwork done right? Is the water depth correct?
- System performance - Have fish arrived in expected numbers and do they breed here?
- Waterway performance - Do streams and ponds have projected aquatic diversity?
- Water quality - Are oxygen levels and turbidity similar to other natural healthy

systems?

- Positive synergy - Have unexpected native species arrived?
- Unexpected negative changes - Have aggressive weeds or voracious foragers arrived?
- Human use - Have people caused negative or positive changes since the work was completed?

When monitoring is given a back seat and monitoring plans are not written until after project work is completed, it is very difficult to decide how and what to monitor. Worse, an ex post facto monitoring plan can be-intentionally or unintentionally-self-serving in that it is tailored to tracking positive results while ignoring project failures.

"Can't be done"? We're doing it!

The concept that we can re-grow healthy prairies, marshes, shorelines, eelgrass beds, forested slopes, and other natural systems has caught on. As with anything new, much debate ensues regarding whether or not it will work. The debate goes back and forth between people who consider the rebuilding of nature to be impossible, improbable, and too costly, and those who reply that not only can it be done, it already has been done and is being done.

Ecological restoration gives us the tools to understand and replicate natural systems in ways that best suit local climate and physiographic conditions. This is what we must do to begin to reverse a planetwide problem. We can begin in our own back yards.

John W. Munro *is a certified senior ecologist who designs and oversees ecological restoration of waterways, wetlands, forests, and grasslands. He also teaches ecological restoration workshops. He may be contacted at Munro Ecological Services, Inc., 990 Old Sumneytown Pike, Harleysville, PA 19438-1215; 610-287-0671; munroeco@bellatlantic.net.*

Society for Ecological Restoration

The Society for Ecological Restoration (SER) is an international membership organization with the mission of advancing the science and art of restoring damaged ecosystems. SER's members practice and study restoration in nearly all ecosystem types.

Anyone interested in ecological restoration may join. Members receive a quarterly newsletter and may subscribe at reduced rates to *Ecological Restoration/North America* (see Restoration Resources) and *Restoration and Ecology* (the Society's peer-reviewed journal).

SER conference

SER will hold its 10th international conference in San Francisco, September 23-25, 1999. Workshops, field trips, and conference sessions will explore the current practice and science of ecological restoration.

Topics for plenary symposia will be Ecological Restoration of Public Lands; Watershed Politics and Management; and Community, Connection, and Stewardship. The cultural side of restoration--art and restoration, stewardship traditions, and the relationships between people and nature--will be a focus of the conference.

For more information on membership or the conference, contact SER at 1207 Seminole Highway, Suite B, Madison, WI 53711; 608-262-9547; email ser@vms2.macc.wisc.edu; Website http://www.ser.org.

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Strictly Speaking: What "Restoration" Means

In his plenary address at a recent conference, William R. Jordan III--the editor of Ecological Restoration/North America (formerly Restoration and Management Notes) and a founding member of the Society for Ecological Restoration--offered some provocative comments about the meaning of the word "restoration." The following is based on his remarks.

Rehabilitation, reclamation, restoration, preservation--these are sister terms describing a family of management protocols. Some closely related terms are stewardship, healing, recovery, repair. I suggest we use them all--but let's be careful how we define them, because the language we use gets projected on the landscape and ultimately shapes it.

Restoration is the narrowest of these terms, and the most demanding. There is nothing mysterious about it, however. Everyone who speaks English knows what restoration means--it means putting something back the way it was. And not just setting the system back in place, but setting it in motion.

Once we define restoration this way, our goal is defined by history, and it's very strict, very hard-edged. "Rehabilitation" is different in this respect. When we rehabilitate a system--restore certain functions or features--we are restoring selectively. In most instances, we are restoring elements we happen to value, and we are relating to nature as a resource.

Restoration, on the other hand, is a dialogue with nature as given. It is the only management paradigm that is committed specifically to the perpetuation of the landscape on its own terms. And this is a special kind of challenge. Ecologically it is a

challenge because it means learning about the historic system and accurately recreating it--getting everything right in an ecological sense. And it is a challenge psychologically because it means setting aside our tastes and preferences (and even in a sense our creativity) and trying to copy nature--rattlesnakes, poison ivy, fire, and all. In this way, our relationship with the landscape becomes an exercise in humility and self-abnegation.

Restoration is important for both reasons. Ecologically it is important because it is the best strategy for preservation--for ensuring the existence of historic ecosystems in the long run. And psychologically it is important because it entails a uniquely active yet uniquely self-effacing relationship with nature.

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Fixing a Salt Marsh: *Citizens, Shovels, and Sweat*

by Wenley Ferguson

The marsh next to Little Mussa-chuck creek was changing, and you didn't need a degree in ecology to notice it. Year by year, neighbors could see the stands of tall, shaggy *Phragmites australis* advance and spread, crowding out the salt marsh plants that used to thrive there.

The neighbors were concerned, and so was the Barrington Land Conservation Trust, which owns the marsh. The biggest worry was the threat to three rare native brackish marsh plants of special interest in Rhode Island--*Eleocharis rostellata* (creeping spikerush), *Suaeda maritima* (maritime sea blite), and *Scirpus maritimus* (bulrush).

People knew why the marsh was changing. The problems started a few years ago, when a big winter storm piled up sand across the creek's mouth, closing the outlet to Narragansett Bay. With nowhere else to go, the creek water flooded the marsh. The marsh became less and less salty, creating the perfect conditions for invasive *Phragmites* to outcompete brackish marsh plants.

The question was, could the marsh be restored to its former condition? The Land Trust joined forces with Save The Bay, a local advocacy group, and Save The Bay called upon experts from U.S. Fish and Wildlife, the Rhode Island Department of Environmental Management, and the University of Rhode Island for technical assistance. Together, the partners explored the options.

The seemingly obvious remedy was to remove the sand and open up the original creek mouth. However, we concluded that this would provide only a temporary fix. The pattern of sand movement in the area has been affected by nearby seawalls that were built to protect shorefront houses. Since the seawalls couldn't be removed, we suspected that over time sand would re-accumulate at the creek mouth, until eventually another big storm would close off the outlet again.

So we looked for another solution. As it happened, only half a mile away there was another tidal creek with an outlet to the bay. We decided to dig a channel to connect the blocked creek with the unblocked one. Since we weren't going to return the creek to its earlier configuration, our approach might better be termed *rehabilitation* than *restoration* in the strict sense of the term. But we did hope to bring the marsh back to its salty condition, thereby curbing the spread of *Phragmites* and protecting the native brackish plants.

Volunteers do it all

The typical marsh restoration project requires bulldozers, trained operators, and weeks of work. But the small scale of the Little Mussachuck project gave volunteers the rare opportunity to perform all the work by hand. A crew of 70 volunteers ranging from high school students to retired engineers turned out in April 1998, equipped with shovels and buckets. They took just four days to dig a 300-foot channel to connect the two creeks. The route of the channel had been planned out ahead, based on a survey of the natural contours of the marsh, and as the crew dug, Save The Bay staff used a laser level to ensure proper depth and width.

The volunteers had been forewarned that this would be hard, wet, and dirty work, and not a soul complained as they shoveled and hauled hundreds of pounds of saturated peat, then replanted saltmarsh sod.

Volunteer participation didn't end with the construction phase. In fact, it didn't begin there either. Long before we got knee-deep in muck, Land Trust volunteers were out doing a less visible kind of work--explaining the project to neighbors and attending planning meetings. No doubt many people would say that meetings are harder work than ditch-digging--but without meetings there is no restoration project.

About a year before the project, volunteers also drove stakes into the marsh to mark the

boundaries of the *Phragmites.* This simple technique, known as staking, made it possible to track the rate and extent of spread both before and after the rehabilitation.

Now Save The Bay is training volunteers to monitor the long-term success of the project. Volunteers will take annual photos at set locations to track the coverage, height, and density of *Phragmites.* They will also learn to measure soil salinity via homemade salinity wells (PVC pipes dug into the marsh), and to count and identify plant species within transects.

Do you really need a Cadillac?

Restoration does not happen overnight. It may be many years before we know if the project was a success. Thus, monitoring protocols for restoration projects need to be designed with the long term in mind.

The scientific and technical advisors on a project may lean toward the "Cadillac approach"--collecting comprehensive data on a wide range of indicators, to gain maximum knowledge.

But it's important to ask, Who will be here when the agencies and scientists are gone? Who will still be monitoring this site in 5, 10, or 15 years?

It will be the community people, and they may not be able to afford the continuing investment of time, money, and equipment for Cadillac methods.

The Mussachuck project includes both the more comprehensive type of monitoring (the plant transects and salinity testing) and a very simple method (the photographic monitoring). Realistically, the volunteers may not continue the more demanding methods beyond three to five years. But even 15 years from now it's a good bet they will still be taking photos, which will effectively show what progress we are making toward our restoration goals.

First year results

A year after construction the meandering creek carries freshwater out to Narragansett Bay and, during full moon tides, carries the Bay's salty waters into the marsh. The marsh, once flooded with freshwater, is now revealing mudflats. The mudflats were

colonized by creeping spikerush during the first growing season, and are providing a feeding mecca for shorebirds including Greater and Lesser Yellowlegs, Semi-palmated Plovers, Glossy Ibis and Great and Snowy Egrets.

Wenley Ferguson *is Save The Bay's Volunteer Monitor Monitoring Coordinator. She may be reached at Save The Bay, 434 Smith St., Providence, RI 02908; 401-272=3540; wferguson@savethebay.org*

Guide to Effective Outreach

Watershed organizers who want to do a better job of reaching out to their communities will find lots of truly practical advice in *Getting In Step: A Guide to Effective Outreach in Your Watershed.* This attractive, highly readable booklet ranges from broad issues like defining your goals to nitty-gritty details like bulk mailing rates and requirements.

The advice in the book is down-to-earth and specific. For example, the authors offer sample messages that a volunteer group might use to recruit lake monitors from different segments of the community. For senior citizens, suggested messages include "Have some free time? Make a difference" and "Work with your community to improve Lake Townsend." For high school students: "Earn high school credit and get a tan at the same time."

Order *Getting In Step* from Council of State Governments, Publication Sales Dept., P.O. Box 11910, Lexington, KY 40578-1910; 1-800-800-1910; 68 pages; $10 + $4 shipping.

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Using Bioengineering to Restore Paper Mill Run

by Joy Lawrence

When Morris Arboretum set out to restore the portion of Paper Mill Run that runs through Arboretum grounds, we had two goals. The first was to mitigate damages to the stream caused by human activities. The second was to create a demonstration project that could serve as an educational display and model for other projects in the watershed. In particular, we wanted the project to showcase bioengineering--the use of plants and plant materials to restore streambanks. Bioengineering, a relatively new approach in the United States, blends the human science of engineering with the "engineering" services provided by natural systems.

Our second goal acknowledges that the project area represents less than 10 percent of the Paper Mill Run watershed. We cannot bring significant change to our watersheds without the help of our upstream and downstream neighbors.

The problems

Before European settlement, the streams of the eastern United States were largely surrounded by forest. Tree roots, grasses, and shrubs stabilized the streambanks while the forest canopy shaded the water, keeping it cool. The forest floor absorbed rainwater, allowing it to seep slowly into the groundwater. When the stream flooded, its waters spread out gradually over the floodplain.

Urbanization has brought profound changes. Impervious surfaces--roads, rooftops, parking lots--don't behave anything like a forest. Now, instead of being slowly absorbed into forest soils, stormwaters rush in torrents over paved surfaces, picking up mud and pollutants as they go. Much of this is channeled directly into streams by storm sewer systems. When these rushing waters reach a stream like Paper Mill Run, the onslaught cuts away at the stream's banks and bed. Tons of soil are washed into the stream, making the water turbid. For gill-breathing animals, the effect is like trying to breathe in a sandstorm. After the storm, the sediment settles to the bottom, smothering fish eggs and burying the small stones and cobbles that provide habitat for aquatic insects.

Stormwater also carries a myriad of chemicals from lawns and paved surfaces--pesticides, herbicides, leaking fluids from cars, etc. For Paper Mill Run, the most troublesome contaminant is nitrogen from fertilizers, which stimulates excessive algae growth in the stream.

The restoration project

It is impossible to undo all the changes that we have made, but we can try to recreate at least some of the pre-development conditions. At Paper Mill Run, the first step was to regrade the banks (photo 1). Damage from severe stormwater flows had created steep and eroded banks. Wherever possible, we shaped the banks to a gentle slope, reconnecting the stream channel with its floodplain. This will allow the stream to spread out during a storm event, slowing the water velocity and lessening its erosive

power. More sediment will be deposited in the floodplain, and less in the streambed.

When the banks were cut and regraded, bare soil was exposed. It was important to prevent erosion by quickly establishing a stable surface. We used biodegradable coconut fiber logs and matting to hold the soil in place until vegetative cover could become established (photos 2 - 4). Because this material is organic, it provides an ideal medium for establishing new plantings.

The third step was planting the banks (photos 5-7). Streamside plants provide numerous benefits to streams. First, and most obviously, well-developed root systems provide a kind of natural engineering that stabilizes streambanks and resists erosion. The bigger the root system, the better the stabilizing force.

But if stabilization were the whole story of stream restoration, traditional solutions like lining banks with rock (riprap) or concrete would do just fine. We are now coming to appreciate that streamside vegetation provides a whole array of "services" to a stream. Plants take up nutrients that otherwise would run into the stream where they could promote excess algae growth. The soil and plants act to filter and bind pollutants before they reach the stream. Shrubs and trees shade the water, maintaining a suitable temperature for fish. The whole filtering, shading, and stabilizing process protects sensitive aquatic habitats, which is why we speak about creating forest buffers along rivers and streams.

Not every homeowner has the space or inclination to put a forest in their yard. What's important to know is that the bigger the plant, the more it benefits the stream. Traditional lawns have shallow root systems, provide no shade or habitat, and don't absorb much rainwater. Meadows are better, shrub communities better still, and forests best of all. The plantings at Paper Mill Run are designed, in part, to offer a selection of alternatives to traditional lawns. Many of the plants were chosen because of their ornamental qualities.

Which plants to use?

Only plants native to Southeastern Pennsylvania were included in our selections. It is preferable to use regionally native species because they are well adapted to local growing conditions. In addition, native plants work symbiotically with the native animal community. These plants provide essential food and habitat that native animals have come to depend on through generations of evolution. In return, the plants have come to depend on native animals and insects to provide distribution and pollinating services.

A thoughtful restoration must consider the complex relationships between plants and animals. At Paper Mill Run, rather than trying to single out individual species to plant, we modeled our restoration design on a "reference site"--a section of relatively undisturbed stream that closely resembles Paper Mill Run in its water flow, soils, and geology. Our long-term goal is to restore a multilayered system, not just a few species. The reference site helped define the plant species, habitat, and distribution patterns included in the master plan.

In deciding what should be planted where, the first step is a detailed site assessment. How wet are the soils? Only specialized plants will grow at the edge of the stream, which will be continually very wet. As you move up the bank slope, conditions become dryer and a wider variety of plants can be used. Soil chemistry is another important factor. Along the Paper Mill Run, we have very high soil pH which is not suitable for a number of otherwise appropriate regional native plants

Controlling nonnative invasive plants is especially critical along stream corridors because the moving water acts like a highway to efficiently convey seeds to new sites downstream. Aggressive invasives can also quickly overrun a newly planted landscape. The Arboretum will monitor the progress of the new landscape and, based on observation and experiment, establish a responsive maintenance regime to ensure the control of invasives and the health of the new riparian buffer.

Restoration on display

Thousands of Arboretum visitors are expected to pass through the Paper Mill Run demonstration project annually. To enhance their experience, we have designed a full program of education and interpretation. It includes on-site display panels, take-away materials, guided tours, and associated workshops and classes. In a few months, most of the bioengineering materials we used will be covered by plant growth, so it is important that we explain the process that underlies the new landscape as well as the reasons for undertaking the project.

As we come to understand more fully how nature creates and maintains itself, not as a static or rigid entity but as a dynamic and responsive system, we are better able to design and adapt our restoration activities to take advantage of the valuable services nature provides. If there was only one message we could give to every visitor, it would be that each of us is a part of this grand system.

For more information on the Arboretum's restoration projects, visit http://www.upenn.edu/morris/uf/.

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The Paper Mill Run Project, Step By Step

Except for the first step (regrading the banks), the whole project was installed with hand labor by volunteers and Arboretum staff. The project required approximately 1,500 hours of work, about half of which was spent on the planting.

1 Steep, eroded banks were regraded to wider and shallower slopes.

2 A shallow trench was cut at the bottom of the banks.

3 Coconut coir logs (stuffed with the fibrous outer husks of coconuts) were set into the trench. In a few weeks, the logs will fill with silt, providing ideal conditions for establishing the wet-tolerant plants.

4 Coconut coir matting was sewn to the coconut coir logs. Volunteers stitched a total length of almost 1,800 feet; each stitch was 2 inches long.

5 Banks were raked and seeded. (Note: In the area shown here, banks could not be graded to as shallow a slope as elsewhere in the project.)

6 The coconut coir matting was pulled up over the seeded bank and staked into place.

7 Live plants were "plugged" through the mats and sewn or stapled in place. The coconut-fiber material provides a temporary stabilizing mechanism while plants become established. The matting will degrade in 3 to 5 years, and the plant roots will take over the job of stabilizing the bank.

Some Reflections on Bioengineering

"Unlike conventional structures, bioengineered systems grow stronger with age. These are the only systems I know in which this is the case. Time is on our side, so to say.

. . . Soil bioengineering does not directly repair a site as does conventional engineering; instead, it sets in place a mechanical and living foundation on which the land is intended to recover."

--Robbin B. Sotir

(From *Environmental Restoration: Science and Strategies for Restoring the Earth,* ed. John Berger, Island Press, 1990.)

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Volunteer Add "Missing Piece"--Monitoring Restoration

by Donna Meyers

Over the last decade, restoration techniques have become more sophisticated. "Old school" techniques, such as installing rock riprap or cement retaining walls along streams, are increasingly being replaced with bioengineering methods that use natural materials such as large woody debris and willows.

How well are the new techniques working? Unfortunately, the answer in most cases is, We don't know. We don't know because projects aren't being monitored to determine their long-term effectiveness.

Without monitoring, our understanding of what actually works remains poor. We aren't learning from our mistakes, because we don't know that we have made them.

Clearly we still have a lot to learn about how to do successful restoration. A recent article by Mathias Kondolf and Elisabeth Micheli of the University of California cites several studies that found high failure rates in stream restoration projects.1 For example, a survey of 400 instream habitat enhancement structures in Alberta found one-third to be of low or zero effectiveness. Another study of 161 aquatic habitat enhancement structures on 15 streams in western Oregon and Washington found that 18 percent had failed outright and 60 percent were damaged or ineffective.

Monitoring has been the "missing piece" in restoration, and volunteer monitoring groups

are ideally equipped to supply this vital information. Right now, volunteers with the Coastal Watershed Council are doing just that at Arana Creek in Santa Cruz, California (see case study, below).

Adaptive management

Underlying the lack of monitoring is the notion that restoration projects are "completed" once they have been installed. The truth is quite different: adjustments to restoration work may be needed for months or even years after installation.

Recently, restorationists have begun using the term *adaptive management,* which is just a fancy way of saying that you go back and look at what's happening at your restoration site, and if something is not working as intended, you make adjustments. Obviously, that "go back and look" step--i.e., monitoring--is indispensable for adaptive management.

As an example of how adaptive management works, suppose that as part of a stream restoration project you place gravel in the streambed with the goal of enhancing spawning habitat. Following the winter season, you go back and find that most of the gravel has been displaced or washed away entirely. It becomes obvious that your understanding of the hydrology of the stream was not complete--apparently stream flows and scouring capabilities are greater than you designed for. So you re-consult with your hydrologist, who suggests a better area for placing gravel: 150 yards downstream, at the tail of a pool, where flows are slower.

Fear of failure

Sometimes monitoring is neglected because people are afraid of finding out that a project is not performing as well as expected. Ann Riley, an 18-year veteran of urban stream restoration and the author of *Restoring Streams in Cities,* recently spoke about this problem at an urban stream restoration conference. "We need to make mistakes," she said, "and then we need to make mistakes again. We revise our plans and structures on the basis of experience. This is the core of the scientific method--hypothesize, experiment, make a mistake, learn. But making mistakes is discouraged. In school, you get a bad grade. On the job, you lose the promotion."

Riley then told about a technique used at a Coalition to Restore Urban Waters conference to encourage people to talk about their mistakes and learn from them. "We set up an open mike," said Riley, "and we called it the 'I-Screwed-Up' mike. The worse the mistake, the louder the applause. If people misused the mike and talked about successes, they were roundly booed."

No money for monitoring

Funding for monitoring restoration can be very hard to find. Funders like seeing a restoration project constructed--that's the "feel-good" part of the process. It's much harder to get them interested in monitoring, which takes a long time and is largely invisible. Even when monitoring is included in the original budget, cost overruns during the construction phase often eat up the money earmarked for monitoring--because monitoring is seen as secondary and relatively expendable.

Educating funders

I have found that funders are willing to support monitoring once they understand its importance. For the Coastal Watershed Council's restoration project at Arana Creek, I invited folks from the National Fish and Wildlife Foundation'California Salmon Initiative to visit the site. There, I pointed out exactly what we wanted to monitor and explained why the information was crucial to a successful project. Once they saw the need, the Foundation was happy to fund our pre-project monitoring.

Here are some points to emphasize when talking with potential funders about why monitoring is important.

- Pre-project monitoring is even rarer than post-project monitoring, yet it's critical for two reasons. First, understanding existing problems and conditions lets you design a restoration project that will improve your stream's ecological health the most. Second, pre-monitoring provides a quantified starting point against which you will be able to measure the project's effectiveness.

- Post-project monitoring is essential for adaptive management. It's also the only way to evaluate the project's long-term success. Explain to funders what parameters you will track and what kinds of adaptations you will make if your monitoring tells you that the project is not functioning as expected.

- The cost of monitoring is relatively low and the benefits are great. Long-term monitoring not only benefits your own project but also becomes part of the overall knowledge base about restoration, advancing our understanding about what works and what doesn't.

Types of post-construction monitoring

Post-construction monitoring most often falls into one of three categories: (1) implementation monitoring, (2) compliance monitoring, and (3) effectiveness monitoring.

The first two types are the most common and least expensive. Unfortunately, they are also very limited. They are not long-term, and they usually do not evaluate improvements to habitat. Implementation monitoring simply asks whether the project was built according to the construction plans. Compliance monitoring is usually used to evaluate mitigation projects--for example, a wetland that is being restored by a developer to compensate for environmental damage elsewhere. It asks, Did the project meet the permit requirements attached to it?

Data on channel width and water depth, such as these volunteers are collecting on a stream near San Jose, California, are needed for restoration planning and project design.

Effectiveness monitoring is the most important ecologically. It also requires more money and effort, and a long-term commitment (generally 3 to 10 years). Effectiveness monitoring asks whether the project met the objectives of the restoration plan. It includes questions like, Did the project result in more pool habitat within the restoration area? Did canopy cover increase to the extent specified in the plan?

Case study: Arana Creek

In Santa Cruz County, California, the Coastal Watershed Council, in partnership with the Arana Gulch Watershed Alliance, has begun restoration of a 700-foot section of Arana Creek. A volunteer monitoring program coordinated by the Watershed Council has collected information to document pre-project water quality, macroinvertebrate communities, and instream and riparian corridor conditions. The project plans are completed and construction will begin this summer. Removal of nonnative plants, and planting of natives, has already begun.

The restoration project aims to remedy problems associated with a cement fish ladder constructed in the stream several years ago. The fish ladder structure dropped the streambed elevation by almost 3 feet, resulting in an incised channel and streambank failure. The nearly vertical walls along the stream have receded almost 3 feet over the last three years, contributing many yards of sediment to downstream areas. Data from our volunteer monitors showed decreased macroinvertebrate counts and diversity, and increased sediment, downstream from the structure.

Our restoration plans call for resloping the streambank and stabilizing it with bioengineering techniques such as willow revetments and wattles. With help from volunteers, we are removing nonnatives and planting seeds collected from native riparian species growing at the site.

Pre-project monitoring

Extensive pre-project monitoring by Coastal Watershed Council volunteers helped guide the design for the restoration. Data collected by volunteers included:

- **Physical monitoring:** Volunteers helped complete a longitudinal profile of approximately 3,000 feet of stream and mapped cross-sections within the restoration area. They also recorded stream flow information both during high water and in low-flow months.

- **Habitat monitoring:** Using protocols developed by the California Department of Fish and Game, volunteers conducted an instream habitat survey. They recorded information about the number and size of pools, riffles, and runs along the restoration area; the percent canopy cover; and the condition of the streambank both upstream and downstream of the restoration site.

Post-restoration monitoring

The information collected by the volunteers helped us set quantitative habitat enhancement goals for the project--goals like increasing canopy cover by 100 percent over the next five years, increasing the amount of pool and riffle habitat by 50 percent, and reducing nonnative plants by 75 percent over five years.

We designed our post-restoration monitoring program hand in hand with the restoration plan so that it reflects the project's goals. Monitors will be looking for such changes as increased pool habitat, increased canopy cover, improved bank stability, increased macroinvertebrate diversity, and decreased nonnative plants. Monitoring will be conducted by volunteers under the guidance of technical advisors.

The extensive pre-project data collected by the volunteers provides a baseline from which we can evaluate how well the restoration is succeeding. If we find that some goals are not being met, we will practice adaptive management. For example, our restoration plan calls for placing large rootwads in the creek at certain places. The rootwads are intended to cause scouring, which in turn will create pools. If we go back a year later and find that in some areas scour pools have not formed, we will need to either reposition or remove the rootwads in those areas.

The Coastal Watershed Council and the Arana Gulch Watershed Alliance are committed to monitoring and maintaining the site for at least five years. Physical parameters, biological populations, and habitat conditions will be monitored annually, giving volunteers the chance to see firsthand how they have positively impacted the creek whose stewards they have become.

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Stand By Your Project: *or, Don't Plant 'Em and Leave 'Em*

by Brian Stark

Our first riparian revegetation project was installed in April of 1997. I remember it as if it were yesterday . . . probably because I was still working on it yesterday. Yes, long after the fun of planting a few thousand trees, maintaining the site is still an ongoing chore for the Land Conservancy of San Luis Obispo. In contrast, a project we installed in the spring of 1998 requires much less maintenance today and costs us little in time and money.

Why such a disparity in maintenance requirements and costs? The principal factor is *maintenance planning.* In order for the environment to benefit from trees, the trees have to be alive. Only through active maintenance will plants survive and a project be successful over the long term.

Today when I think of doing a revegetation project I put much more thought into planning for maintenance than into the logistics of planting day. Here are a few tricks we've used to help us reduce maintenance costs and effort.

The **timing** of project installation makes a big difference. Here in central California, where summers are long and dry, irrigation is a principal concern. Planting in the fall, just prior to the rainy season, reduces irrigation needs as seasonal rains pick up the job. In flood-prone areas, however, spring plantings followed by one summer of irrigation have been more successful. If you irrigate, do so on a regular schedule planned well ahead of time. One missed watering can kill the whole project.

When we are working along a stream with grazing animals, **animal management** becomes an important part of our maintenance strategy. This requires materials such as fencing, as well as time for installation.

We've also learned that the animals themselves can be great project maintenance tools. With proper planning and management, the right animal at the right time for the right duration can do a lot of weed control without damaging new natives. Animals make excellent "volunteers" because they work for food and bring their own tools!

At one of our sites, grasses were competing with native stock. We set up a temporary enclosure and introduced cattle for a 6-hour period. Afterward we could see that the cattle had eaten the grass and not the native shrubs.

Because animal management can be time-consuming and depends on intensive monitoring, it is critical to plan ahead in conjunction with the land manager. Remember that costs associated with animal control are recouped by reduced weeding costs.

Project maintenance can require significant **labor resources**. We do most of our maintenance with volunteers. In fact, each site has a volunteer site steward who helps manage maintenance activities. The site steward makes regular monitoring visits and reports the site conditions back to the project manager. Site stewards also help recruit and manage volunteers for the maintenance effort, and prepare monitoring and maintenance reports.

I have saved my best hint for last: proactive weed control. Weeds are the biggest threat to a new project, and pulling weeds is not much fun. It's much harder to retain a volunteer force for weeding than planting. So, it's vital to plan ahead to reduce weed growth on your site. There are several ways to do this, but the best way is mulch. Around every new plant, apply wood chip mulch in a ring measuring at least 4 feet in diameter. The mulch should be 3-4 inches deep at a minimum, but only 1/2 inch at the immediate base of the plant (otherwise it will rot the stem).

Mulch does two important things: it reduces weed growth dramatically, and it helps retain soil moisture, reducing watering costs. If you have sufficient mulch, apply it more extensively on the project site to control weeds. Mulch should be included in your project budget, but we have also obtained free mulch from local tree trimmers, highway maintenance crews, and our municipal tree trimmers.

Through effective maintenance planning, the Land Conservancy of San Luis Obispo County has reduced annual per-acre maintenance costs on newer projects to roughly half that of our first projects. The improved maintenance has also resulted in increased plant

growth, allowing new plants to compete more effectively with weeds. Now when I go to monitor our newer enhancement sites I can bring my lunch . . . instead of my machete.

Brian B. Stark *is Deputy Director of the Land Conservancy of San Luis Obispo County, California. For more information, see* *http://www.slonet.org/vv/land_con/*

Bugs in the Web!

Two Websites offer macroinvertebrate descriptions and drawings specifically aimed at volunteer monitors. Volunteer groups are welcome to "steal" these materials for use in their own manuals and brochures.

The *Field Guide to Freshwater Invertebrates*, prepared by Leska S. Fore and illustrated by Annabel Wildrick, is at http://www.seanet.com/~leska/. The drawings can be downloaded in GIF format and opened in a word processing or drawing program.

For another site that's full of bugs, check out http://imc.lisd.k12.mi.us/msc1/invert/inverts.html.

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Funding for Community-Based Habitat Restoration

A volunteer records trash survey data at a wetland restoration project coordinated by the National Aquarium in Baltimore.

Over the past four years, the National Marine Fisheries Service (NMFS) Restoration Center has provided financial support to 56 grassroots restoration projects through its Community-Based Restoration Program. While the projects are very diverse, all share these essential elements:

- direct, on-the-ground habitat restoration
- benefit to living marine resources
- community participation

The following examples illustrate the range of projects funded by the Restoration Center:

- **Wetland Restoration** (Baltimore, MD). The National Aquarium in Baltimore is coordinating the restoration of a small wetland in a highly urban area. The geographical position of the marsh is such that high tides and heavy rains deposit large amounts of trash and marine debris there. Community volunteers will regularly remove this trash.
They will also work to eradicate invasive common reed *(Phragmites australis)* and plant beneficial marsh vegetation.

In just two days, 200 high school and elementary students planted 2,000 native trees along a 1.5-mile stretch of Brush Creek.

- **Fish Passage** (Petaluma, CA). At Adobe Creek, high school students and other community volunteers constructed a permanent step-pool fish ladder system for steelhead trout and chinook salmon.

- **Creek Restoration** (Santa Rosa, CA). Brush Creek lost its natural foliage when it was channelized for flood control. Without shading, the water gets too hot for juvenile salmon and steelhead trout to survive. The Brush Creek restoration project's goal is to bring back the fish by planting trees to provide shade.

- **Pepper Busters** (Melbourne, FL). Brazilian pepper, an introduced nonnative tree, has become the #1 invasive species in Florida. The trees grow to an average height of 40 feet, and the leaves secrete a substance that poisons other plants as well as birds. Volunteer Pepper Busters, organized by the Marine Resources Council of East Florida, remove the pepper using the "cut stump" method. The trees are cut down with a chain saw and the stumps are treated with herbicide to prevent regrowth.

Seventh-graders from Radnor Middle School plant native wetland shrubs along a pond edge. The banks have been covered with matting made from natural coconut fiber, which will help prevent erosion while the plants become established.

The goal of the Community-Based Restoration Program is to encourage hands-on, locally driven restoration efforts to restore coastal fisheries habitat. Grants typically fall in the range of $5,000 to $50,000 and usually cover a one-year period. The Restoration Center also partners with the Fishamerica Foundation to jointly fund projects; to date, about 25 restoration projects have been funded through this partnership.

For more information about funding opportunities, including proposal guidelines and application deadlines, visit the NMFS Restoration Center Website at http://www.nmfs.gov/habitat/restoration/; or call Robin Bruckner or Chris Doley at 301-713-0174.

Monitoring Workshop

Each summer, the Student Watershed Research Project (SWRP) offers an intensive 5-day technical training workshop in monitoring, designed for teachers (8th'12th grade and college), community organizations, and professionals. Instructors include university professors, research scientists, and classroom teachers. For detailed information visit http://www.ogi.edu/satacad/swrp/ or contact Stacy Renfro, SWRP, Saturday Academy/OGI, P.O. Box 91000, Portland, OR 97291; 503-748-1363; renfro@admin.ogi.edu.

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Restoring a Coastal Scrub Community

by Eleanor Ely

Marianne Kjobmand is showing a visitor around the dune revegetation project she coordinates at Half Moon Bay State Beach, on the California coast about 25 miles south of San Francisco.

Pointing with pride at a clump of big, healthy-looking bushes firmly rooted in the sand, she says, "This lupine was planted last year by a group from a pharmaceutical company."

A few steps further on she points again: "See the grayish plants on that dune over there? That's lizard tail. That was planted by students from Woodside High School." Waving her arm toward some low dunes closer to the ocean, she adds, "Over there is where a Girl Scout troop pulled up

Girl Scouts, along with their parents and siblings, remove iceplant from

and hauled away 120 garbage bags of iceplant last month."

dunes. The volunteers are careful to avoid damaging the small patches of natives, like wild strawberry and beach primrose, which will now be able to spread and fill in the area.

The whole tour goes on the same way: "Bay Area Action volunteers spread the mulch on this area here... Kids from Sea Crest School planted this yarrow... Tomorrow, volunteers from a bioscience company are coming out to pull wild mustard ... "

It sounds as if Kjobmand has gotten just about everyone in the whole county out here weeding or planting. One begins to wonder if she is some kind of genius at rounding up volunteers.

Well, she has to be. The area being revegetated is huge. It covers 40 acres, stretching along 2-1/2 miles of dunes and marine terrace (the flat area behind the dunes)--and three years ago, when the project started, 95 percent of it was covered with nonnative invasive species.

The native coastal scrub community was destroyed in the late 1800s to make way for farming on the fertile terraces. The goal of the Half Moon Bay Dune and Bluff Restoration Project, funded by the California Department of Parks and Recreation, is to re-establish the native scrub.

Although agriculture stopped in 1955 when the state acquired the land as a State Beach, the natives did not return. "By that time," says Kjobmand, "so many nonnative weeds and grasses had become established that the natives couldn't get a foothold." Kjobmand explains that the weeds arrived along with farming, their seeds stowing away in hay bales or on the coats of sheep or cattle.

"Some of the nonnatives are very aggressive," says Kjobmand. "Outside of their native ecosystem, they don't have the natural competition with which they evolved. Wild radish can grow 2 feet in a month--the natives don't have a chance."

The restoration work at Half Moon Bay is extremely labor-intensive. Almost all the weeding and planting is being done by hand, by volunteers.

"Working by hand, you can specifically pull weeds while leaving the native plants," explains Kjobmand. She adds that controlled burning, a technique used in other locations to kill nonnatives while allowing most natives to survive, can't be used here because of nearby houses. Power tools can't be used either, because of concern that they could harm birds, snakes, or other wildlife.

As every gardener knows, pulling weeds is never a one-time activity. Volunteers return

repeatedly to weed revegetated sites.

"Wild radish, mustard, and poison hemlock seeds are viable for three years," says Kjobmand. "If we can pull the young plants before they go to seed for three years in a row, the nonnative seed bank in the soil will be very much decreased."

"Ongoing maintenance is really important to include in your initial project planning and funding," she adds. "Without help, the newly planted native seedlings won't survive. There's no way a project like this could be a one-year project, no matter how much you did."

Girl Scouts from San Carlos, California, plant mative shrubs.

The planting is just as painstaking as the weeding. Volunteers collect seeds from native plants like beach primrose, yarrow, and coyote bush. Local nurseries grow the seeds, and in a year or so, when they reach gallon size, volunteers plant them.

"We hope that once we bring back the native plants, we'll also get more native insects and birds," Kjobmand says. "We're especially interested in improving habitat for three threatened or endangered species--the San Francisco garter snake, the red-legged frog, and the snowy plover."

About 6,500 volunteer hours have gone into the project to date. So, what is Kjobmand's secret formula for rounding up so many volunteers, from so many different organizations?

"You just keep trying," she says.

Kjobmand has put articles and announcements in the newsletters of native plant societies, Audubon, and similar organizations. She goes to fairs, bringing a display and piles of brochures to hand out. She posted information about the project on the Web at www. volunteermatch. com, which is (as the name suggests) a service that matches volunteers and projects.

High schools are an excellent source of volunteers, especially since students are required to perform 35 hours of community service before graduation. Kjobmand got lots of responses when she listed her project in a newsletter that's distributed to schools.

"Whenever I'm not in the field, I'm recruiting," says Kjobmand.

For more information on the Half Moon Bay Dune and Bluff Restoration Project, contact Marianne

Kjobmand, Half Moon Bay State Beach, Department of Resource Ecology, 59 Kelly Ave., Half Moon Bay, CA 94019; 650-726-8801.

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Native Plant Nursery

In 1994, the U.S. Army closed its base at the Presidio in San Francisco and the land became part of the Golden Gate National Recreational Area (GGNRA), administered by the National Parks Service. GGNRA made a commitment to conserve and restore the Presidio's native plant communities, and established the Presidio Native Plant Nursery to provide native plants for use in revegetation efforts.

From the beginning, the nursery was conceived as a largely volunteer project. "Since we're right in the middle of an urban area, we wanted the neighbors to be involved in stewardship--to feel that it is truly their backyard," says Betty Young, GGNRA Nursery Specialist.

The Presidio Native Plant Nursery is a big operation, with two large greenhouses and several shade houses (where plants are covered by a shade cloth but otherwise exposed to the elements). Each year, the nursery grows 50'60,000 native plants, of more than 75 species.

Volunteers transplant seedlings into pots at Presidio Native Plant Nursery.

Under the direction of a small paid staff, volunteers do everything from seed collection to propagation to planting. Seeds are harvested within the

Presidio to maintain genetic integrity. Winter is planting season, when volunteers brave mud and rain to plant new seedlings in salt marshes, along streams, and on dunes. Last year community volunteers, AmeriCorps members, school classes, and corporate groups contributed over 10,000 hours of work.

Young explains that the Presidio's nursery is different from a commercial nursery. "Commercial nurseries usually grow plants from cuttings, not seed," she says. "Also, they're set up to grow huge batches of one species, while we grow small batches of many different species. We are very precise in our record-keeping and labeling. We want to be confident that we know exactly where each plant came from."

It would be prohibitively expensive to pay for this kind of careful, labor-intensive work. "With the volunteers," says Young, "we can make it work economically and we can do it right ecologically."

Funding Directory

River Network's 1999 Directory of Funding Sources for Grassroots River and Watershed Conservation Groups lists foundation, corporate, and government funding sources. For each source, the 70-page Directory provides contact information, deadlines, grant sizes, and a brief description of the funder's particular interests. Also includes a section on writing grant proposals and a bibliography of state and local foundation directories.

Available from River Network, 520 SW 6th Avenue, Suite 1130, Portland, OR 97204-1535; 503-241-3506. $35 (or join River Network and get a free copy).

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Using Monitoring Data to Choose Planting Sites for Underwater Grasses

by Peter Bergstrom

This century has witnessed declines in submerged aquatic vegetation (SAV) in many estuaries and coastal areas. The loss has serious consequences because these underwater grasses--defined as vascular plants that grow in shallow water up to the surface or slightly above it--are keystone species within their ecosystems. Among other benefits, they provide habitat for fish and food for birds, absorb nutrients from the water column, improve water clarity, and produce oxygen.

Discouraging results

In an effort to bring back these crucial grasses, many volunteer and professional groups are experimenting with planting SAV. I use the word "experimenting" because so far the success rate has been disappointingly low--and not just for volunteers. In Chesapeake Bay, scientists and other professionals have attempted SAV planting at some 50 sites. While many sites showed growth after 1 year, fewer than 10% still had plants 2 or 3 years later.

A 90% failure rate sounds bad enough, but the full story may be even more depressing. Since it's difficult to grow SAV in nurseries, SAV species for planting projects are commonly harvested from another part of the estuary. If the donor beds do not revegetate fully, a failed planting could actually represent a net loss of SAV in the

estuary as a whole.

Can we do better?

In Chesapeake Bay, we have found that careful choice of sites and species improves the chances for planting success. This is where volunteer monitoring data comes into play. The process of targeting sites and species relies on several kinds of data--especially Secchi depth, water temperature, and surface salinity--that are frequently collected by volunteers.

Volunteers plant submerged aquatic vegetation in waist-deep water in Chesapeake Bay.

Choosing sites and species is a three-step process:

1. Determine what general areas in the estuary have good conditions for SAV.

2. Choose the best species to plant in those general areas.

3. Pinpoint the best specific sites for planting within the general areas.

Step 1. Finding good general areas

To support SAV growth, an area must provide adequate light and also be deep enough to keep the SAV submerged at all times. SAV won't grow in places that are exposed at low tide, or in water that's too murky or too deep for adequate light penetration. In very murky water, the only areas with enough light may be exposed at low tide, leaving no place where SAV can grow.

Thus, the first task in choosing planting sites is to map out the zones that provide the needed light levels and water depth. For this you need two sets of data: growing season median Secchi depth, available from volunteer monitoring or other sources; and tidal range, which can be found at the National Oceanic and Atmospheric Administration (NOAA) Website (listed below).

If you have additional monitoring data--especially for total suspended solids, chlorophyll a, dissolved inorganic nitrogen, or dissolved inorganic phosphorus--these can also help identify good general areas for planting.

The Chesapeake Bay Program Website (listed below) provides the specific values for Secchi depth and other water quality parameters that meet SAV habitat requirements in Chesapeake Bay.

Step 2. Choosing species

Different species of SAV have different tolerances to temperature and salinity (for example, eelgrass cannot tolerate high temperatures). Thus, data showing the annual ranges for surface salinity and water temperature will help you decide which species to plant. Here again, information collected by volunteer monitors can play a crucial role.

Step 3. Pinpointing the best spots for planting

Steps 1 and 2 can be done without leaving your desk. Now it's time to go out in the field and take a closer look at prospective sites. Visit sites at both low and high tide. Look for sites with broad shoals about 0.5 ' 1 meter deep at low tide. The presence of some SAV growing at or near the site is a good sign. Check the sediment type--like Goldilocks, SAV prefers a bed that's not too hard and not too soft.

Pick sites with low to moderate wave action. Heavy waves will wash out SAV before roots can get established. On the other hand, some water circulation is desirable, to prevent SAV from becoming choked with algae.

Avoid sites that have any obvious threats to SAV--for example, mute swans, cownose rays, human activities that disrupt bottom sediments, or nearby potential sources of contaminated runoff (golf courses, marinas, etc.).

While the above site selection process should improve SAV planting results, success is by no means guaranteed, so it pays to proceed slowly and carefully. It's best to plant two or three specific sites in the same general area, to find the one where SAV grows best. We recommend starting with small test plantings (500 - 2,000 plants) at each site, and monitoring their success for several years before doing a large planting.

Keep in mind that in some states--including Maryland--a permit is required for collecting and planting SAV.

Finally, the most important advice of all: Don't do any SAV planting without advice from experts in your area! SAV experts may be found at a nearby research university or marine science center; readers can also contact me (address below) for some recommendations.

More detailed guidance on selecting sites, as well as for the actual planting, will be

provided in a document being prepared by Maryland Department of Natural Resources staff, with input from myself and other managers and researchers with experience planting SAV in Chesapeake Bay. If you would like to receive a copy when it is completed, send an email to tparham@dnr.state.md.us, or write to Tom Parham, MD DNR, Tawes Office Building, Annapolis, MD 21401.

Websites:

- For tidal range data: National Oceanic and Atmospheric Administration (NOAA) Website at http://co-ops.nos.noaa.gov/bench.html. Look for the nearest stations. Tidal range is the MHHW value, if one is given, or the MHW value. (MHHW = mean higher high water; MHW = mean high water.)

- For Chesapeake Bay Program SAV information, including habitat requirements: www.chesapeakebay.net/bayprogram/facts/sav.htm (also has links to related sites.); and http://www.dnr.state.md.us/bay/sav/.

Peter Bergstrom *is a biologist with the U.S. Fish and Wildlife Service in Annapolis, MD, and chair of the SAV Workgroup of the Chesapeake Bay Program. He may be reached at 410-573-4554; peter_bergstrom@mail.fws.gov.*

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Volunteer Monitors Get Voice on National Council

by Linda T. Green

In August 1997 I received an intriguing phone call from the U.S. Geological Survey's (USGS) Office of Water Information. Would I be interested in representing the volunteer monitoring community on a newly formed council--the National Water Quality Monitoring Council?

I had a lot of questions, the first being, How many other volunteer monitoring representatives will there be?

The answer: Just you.

How big is the Council?--Thirty-five members, from federal, state, tribal, and local governments, watershed groups, universities, and the private sector.

How often does it meet?--Three or four times a year, for two to three days.

I accepted the invitation to join, and not long afterward found myself sitting with the rest of the Council in a gray, windowless room at USGS headquarters in Reston, VA. It didn't take me long to discover, much to my chagrin, that most of my fellow Council members had very limited knowledge of volunteer monitoring. So I set myself the task of educating these influential and concerned folks. My goal is to make sure the efforts of the volunteer monitoring community are recognized and applauded, and integrated into

the nationwide water quality monitoring strategy.

You may be thinking, What is the National Water Quality Monitoring Council, and why does it exist? Here's what I've learned.

The Council is co-chaired by the Environmental Protection Agency (EPA) and the USGS. It is officially charged with implementing a nationwide strategy to improve water quality monitoring, assessment, and reporting. If this sounds like a big task, it is.

At first, I was nearly overwhelmed with the alphabet soup of agency acronyms and spent a lot of time listening to agency representatives discuss how they were working hard to collaborate with each other. Apparently it had been a big hurdle just to get some agencies to agree that other agencies could produce credible data (sound familiar?). Elizabeth Fellows from EPA spoke eloquently about the need for data "harmony" rather than a lock-step use of "approved" methods. I soon recognized that many issues we as volunteer monitors face were mirrored in the Council's discussions.

One of the Council's major goals is to promote the use of comparable methods by different organizations and in different parts of the country. Another important task is to prepare an on-line compendium of monitoring methods, with guidance on their uses.

Is the Council aware of the wide world of volunteer monitoring? They are now! Several volunteer monitoring colleagues and I have made presentations to the Council and also delivered volunteer monitoring papers at the first National Water Quality Monitoring Conference, in 1998. I am now chair of the Outreach Goal group and on the planning committee for the next conference.

The second National Water Quality Monitoring Conference will be held April 25'27, 2000, in Austin, Texas (for conference updates, check http://nwqmc.site.net/). I am very excited to announce that the Sixth National Volunteer Monitoring Conference has just been scheduled in conjunction with this conference (see announcement below), providing volunteer monitors and professionals with the opportunity to learn from each other.

For more information on the National Water Quality Monitoring Council, see http://water.usgs.gov/wicp/.

Linda Green is the Program Director for University of Rhode Island Watershed Watch. She may be reached at uriww@etal.uri.edu; 401-874-2905.

Date Set for National Volunteer Monitoring Conference

The date and location for the Sixth National Volunteer Monitoring Conference have just been set. The conference will be held April 27'29, 2000, at the Hyatt -- Town Lake in downtown Austin, Texas, directly following the National Monitoring Conference (see above). Save the date!

More information will follow soon on the EPA volunteer monitoring Website (http://www.epa.gov/owow/monitoring/vol.html) and in the Fall issue of *The Volunteer Monitor.* All newsletter subscribers will also receive a mailed conference announcement.

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Making Your Restoration Project Happen

by Carol Cloen

Since 1992, the Delaware Riverkeeper Network has been restoring riparian buffers with bioengineering, or "soft," technologies. Unlike traditional "hard" engineering techniques that rely heavily on concrete and rocks to stabilize streambanks, bioengineering makes use of living and dead plant materials. The end result is a vegetated streambank held in place by plant roots. (For more on bioengineering techniques, see "Using Bioengineering to Restore Paper Mill Run")

As of this writing over 1,000 volunteers have worked on Riverkeeper-initiated projects to restore almost 5 miles of streambanks. Besides sponsoring our own restoration projects, Riverkeeper also advises and supports a number of other citizen groups, government agencies, businesses, and researchers active in riparian restoration.

Through our work we've come to realize that while all restoration projects begin with the desire to do the ecologically friendly thing, that desire is tempered by the realities of money, site location, labor availability, and methodology. A well-developed plan is essential--but so is the ability to adapt that plan as needed to deal with changing conditions. What follows are a few of the lessons we've learned:

1. Be practical in selecting sites

In theory, a streambank restoration project starts with identifying the most severely

eroded sites. In reality, the most degraded site is not necessarily the one you work on. Site selection is frequently dictated by where you can do the work and includes factors such as landowner interest, accessibility to work crews, and finances.

In order to showcase bioengineering as an affordable, ecologically sound alternative to concrete and riprap, the Perkiomen Valley Watershed Association decided to construct a Demonstration Restoration Project. Despite the fact that there were plenty of eroded sites in the watershed, it took almost two years of searching to find a landowner who believed bioengineering would work and was willing to participate. The project was finally situated on township-owned land, at Groff's Mill Park on the East Branch of the Perkiomen.

Ideally, a demonstration project is carried out at an easily accessible site where the needed restoration is simple and straightforward. While the Groff's Mill site was accessible, the restoration was not simple. The steep and severely eroded bank was closely bordered by a park road, making changes to the grade difficult. In addition, the bank was routinely scoured by ice jams. The Perkiomen Valley Watershed Association overcame all the obstacles and in the spring of 1997 partners from the county, township, local citizen groups, and a design firm regraded the slopes and installed coconut coir logs and mats, ice deflectors, and plants.

The Delaware Riverkeeper Network

The Delaware River watershed encompasses some 13,000 square miles and includes parts of Delaware, New Jersey, New York, and Pennsylvania. Since 1988, the Delaware Riverkeeper Network has been actively working to strengthen citizen protection of this watershed.

Riverkeeper's four main program areas--advocacy, volunteer monitoring, enforcement, and riparian restoration--are all parts of the same puzzle, each contributing a piece toward the protection and restoration of the watershed.

2. Be realistic in defining goals

After analyzing both the site and all the available data, you may find that what the site needs and what you and the landowner are willing or able to do are not the same thing. By defining realistic project goals in the beginning and sticking to them, you can get maximum benefit from the effort and money invested.

Like many urbanizing watersheds, the Wyomissing Creek suffers from increasing rates of erosion and nutrient pollution. It also supports a small trout population. To completely correct the degradation would have meant regrading and stabilizing thousands of feet of eroded bank, redirecting stormwater inputs, excluding livestock from the channel, and reforesting--all at a cost of hundreds

of thousands of dollars.

In defining its goals for the restoration of the creek, the Tulpehocken Chapter of Trout Unlimited decided early on to maximize its resources by focusing primarily on reforesting the entire stream. It is hoped that, over time, reforestation will decrease erosion and allow the stream to heal.

3. Find partners

While our tactics may differ, the goal of protecting and restoring ecosystems is shared among environmental organizations, businesses, and regulatory agencies. Developing partnerships with these groups can ease the burden of permitting, and bring additional monies, bodies, and technical expertise to the work. Seeking professional support at the very beginning of the project can help you avoid pitfalls.

The Perkiomen Valley Chapter of Trout Unlimited (TU) tackled their first streambank fencing and planting project by themselves, and the small organization barely survived the stress. "One day, three volunteers showed up and we had to move about 10 tons of rock," recalls Lou Wentz, Conservation Coordinator for the chapter. "We just looked at each other and said, 'Never again!"

Soon afterward, though, a farmer asked TU to help him install a similar project. "By that time," says Wentz, "we'd had a chance to step back and take a breath, and we were starting to feel good about the positive effects of the fence." So rather than say no, the chapter asked the Delaware Riverkeeper Network to take the financial and technical lead on the project.

Additional partnerships led to the Pennsylvania Game Commission and U.S. Fish & Wildlife Service fencing the stream and installing cattle crossings, reducing Riverkeeper's out-of-pocket costs from over $15,000 to less than $5,000. Meanwhile, TU volunteers wielding chainsaws worked to clear the nonnative invasive plant multiflora rose from the streamside buffer zone, and Riverkeeper's science consultants at the Patrick Center for Environmental Research contributed technical expertise and designed a long-term monitoring plan.

4. Designate a project coordinator

Coordination--the least glamorous part of a restoration project--includes negotiating with landowners, keeping track of the budget, ordering materials, scheduling deliveries, recruiting volunteers, hiring and scheduling contractors, renting tools . . . the list goes on

and on! Our experience is that each site needs its own manager who is ultimately responsible for shepherding the job through to completion.

5. Take good care of volunteers

For larger projects, it's a good idea to assign a separate person to do volunteer recruitment--a project in itself! Restoration work is labor-intensive and without bodies there is no project.

It's also important to determine what types of work should be done by volunteers and what might be better left to professionals. The staff time needed to train and supervise volunteers to correctly install coir logs and mats, for example, may be more than you can afford. Identify age- and strength-appropriate tasks as well--with supervision, 10-year-olds can plant a tree, but probably shouldn't swing a 20-pound sledge hammer! Lastly, but most importantly, reward both your staff and volunteers--soda, lunch, sun block, and a boom box can go a long way toward relieving dry throats and sore muscles.

6. Involve the community

Community support is essential to restoration work--not just for funding and volunteer recruitment, but to begin the work of changing the laws and attitudes that necessitated the project in the first place. Get schools, churches, and town councils involved in your projects. Hold press conferences at the site. Mail out pamphlets. Talk to the people next door to address their concerns. By including the community in your plans you invest them in the project and head off problems down the road.

In particular, don't forget to involve the people who will be responsible for maintaining the site when you're done. We know of two projects that failed to include the maintenance crew in the planning process, with significant consequences. Because they weren't aware of what was expected of them, one crew inadvertently mowed down the newly planted vegetation, while the plants at the other site fell victim to an overzealous application of herbicide!

Carol Cloen *is the Riparian Restoration Manager for the Delaware Riverkeeper Network. She may be reached at Delaware Riverkeeper Network, Schuylkill Office; 610-469-6005; srk@worldlynx.net.*

Equipment Suppliers

Two builders of monitoring equipment--Tom Lawrence of Lawrence Enterprises and Will Young of Aquatic Research Instruments--have earned especially high praise from volunteer monitoring groups.

Dissolved Oxygen Water Sampler- *Aquatic Research Instruments*

"These suppliers really have the needs of volunteer monitors in mind," says Jeff Schloss, coordinator of New Hampshire Lakes Lay Monitoring Program. "They both have a lot of experience with volunteer groups, and they're willing to modify equipment to meet a group's needs."

Lawrence Enterprises features an inexpensive Secchi disk (with a fiberglass measuring tape that doesn't stretch), viewscopes, water samplers, macroinvertebrate sampling supplies such as nets and artificial substrates, and many other items. For a complete product list, visit the Website at http://www.acadia.net/h2oequip/ or contact Lawrence Enterprises, P.O. Box 344, Seal Harbor, ME 04675; ph. 207-276-5746.

Aquatic Research Instruments offers several water samplers, including one for dissolved oxygen; a variety of plankton nets; Surber samplers; and lots more. For more information see http://www.aquaticresearch.com or contact Aquatic Research Instruments, P.O. Box 93, #1 Hayden Creek Rd, Lenhi ID 83465; ph. 208-756-8433.

Guide to Clean Water Act

Intimidated by the thought of trying to decipher the Clean Water Act? Here's help. *The Clean Water Act: An Owner's Manual* manages to translate legalese into language you can understand and use. This attractive, down-to-earth book from River Network explains critical sections of the Clean Water Act, tells how to get involved in regulatory decisions, and provides useful references, Websites, and other resources.

157 pages; order from River Network, 520 SW 6th Avenue, Suite 1130, Portland, OR 97204-1535; 503-241-3506. $25.

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Restoration Resources

Firehock, Karen, and Jacqueline Doherty. **A Citizens' Streambank Restoration Handbook.** Izaak Walton League of America. 1995. This introductory handbook offers affordable, ecologically sound approaches that community groups can use to help restore streams. Stressing the importance of the total watershed system, it discusses land use impacts to streams, the role of streamside vegetation, forces that shape streams, and techniques for diagnosing stream health. Streambank stabilization methods such as planting, reshaping banks, installing live stakes, and using fascines (bundles of live woody cuttings) are explained. Includes two detailed case studies and extensive bibliography, plus a 60-page supplement ("Restoring the Range") on managing and restoring grazed riparian areas. 171 pages. Order from Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD 20878; 800-BUG-IWLA. $20.

(Companion video also available; see below.)

Hunter, Christopher J. **Better Trout Habitat: A Guide to Stream Restoration and Management.** Montana Land Reliance and Island Press. 1991. This highly readable guide to the science and art of habitat restoration for trout and other salmonids stresses the importance of looking at the whole watershed, including land uses. Excellent sections on stream behavior and fish habitat are followed by discussion of various instream structures for habitat enhancement. Case studies of urban, rural, and forested streams highlight a variety of restoration techniques. Illustrated with photos and beautifully detailed drawings. 350 pages. Island Press, Box 7, Covelo, CA, 95428; 800-828-1302. $30 + $5.75 S&H.

Riley, Ann L. **Restoring Streams in Cities: A Guide for Planners, Policymakers, and Citizens.** Island Press. Part how-to manual for stream restoration, part historical overview of floodplain management in the United States, this thorough and well-documented book explains what's wrong with traditional engineering approaches and shows how to use ecologically friendly methods to restore urban streams. 423 pages. Island Press, Box 7, Covelo, CA, 95428; 800-828-1302. Single copies $28 + $5.75 S&H.

Advisors and Reviewers Needed

The Izaak Walton League of America is planning a revision of its Citizen's Streambank Restoration Handbook and would welcome input from people who have worked with volunteers to carry out restoration projects using bioengineering techniques. Anyone who can offer advice or serve as a reviewer for the revised manual is invited to contact Julie Vincentz Middleton at 800-BUG-IWLA ext. 223 or 301-548-0150 ext. 223; email jvincent@iwla.org.

Federal Interagency Stream Restoration Working Group. **Stream Corridor Restoration: Principles, Processes, and Practices**. 1998. This mammoth book (nearly 600 pages), produced by a workgroup of 15 federal agencies, is so comprehensive that it practically constitutes an entire course in basic stream ecology and restoration. Colorful and well-illustrated, it is intended for both the professional and the layperson. Covers stream processes, biology, and chemistry; restoration planning and implementation; and monitoring. Appendices summarize specific restoration techniques. Though the sheer size can be daunting (the table of contents runs to 15 pages and there are 32 pages of references, not organized by subject), this should prove to be a very valuable resource.

Order from NTIS, 800-553-NTIS; $71 + shipping (ask for PB98158348); or download from http://www.usda.gov/stream_restoration/. Also available from NTIS on CD-ROM for $60 (ask for PB98502487).

Boquet River Association. **How to Hold Up Banks: Using All the Assets.** 1996. This booklet contains very practical, realistic advice from a small nonprofit organization that has organized and carried out dozens of streambank erosion control projects. 60 pages. $8, from Boquet River Association, Inc., c/o Essex Co. Government Center, Box 217, Elizabethtown, NY 12932; 518-873-3688.

USDA, Natural Resources Conservation Service. **Streambank and Shoreline Protection (USDA Engineering Field Handbook, Chapter 16).** 1996. More technical than most of the resources listed here, this handbook includes detailed instructions for protecting streambanks through bioengineering as well as more traditional methods. Covers bank reshaping, live stakes, fascines, branchpacking, cribwalls, brushmattresses, rock riprap, coconut fiber rolls, rock gabions, and more. 141 pages. Order from NTIS; 1-800-553-NTIS (ask for PB98114358). $33.

Illinois State Water Survey. **Field Manual of Urban Stream Restoration.** 1998. This fairly technical manual presents methods used in several Midwestern urban streams for pool and riffle creation and streambank stabilization. Many photos and drawings. 146 pages. Available from Conservation Technology Information Center, 1220 Potter Dr., Room 170, West Lafayette, IN 47906; 765-494-9555; ctic@ctic.purdue.edu. Single copy $25; additional copies $20.

IL State Water Survey has also produced a number of videos illustrating stream restoration techniques. $35 each; for a complete list, contact Jon Rodsater at IL SWS, P.O. Box 697, Peoria, IL 61652-0697; 309-671-3196.

Finlayson, Christine. **Tools, Trees, and Transformation.** The Wetlands Conservancy. 1997. This collection of 25 stories about restoration projects in the Portland, Oregon, area is rich in real-life experience. Nearly every story discusses the difficulties and hurdles overcome and the lessons learned. The projects described are all citizen-initiated, and many involve school classes, making this book especially useful for teachers. 137 pages. The Wetlands Conservancy, P.O. Box 1195, Tualatin, OR 97062; 503-691-1394. $15 + $3 S&H.

Pennsylvania Department of Environmental Protection. **Pennsylvania Stream ReLeaf Forest Buffer Toolkit.** 1998. Practical instructions for planting trees to create buffer zones along streams. Topics include project design, types and sizes of plants to use, site preparation, tools and equipment, and planting methods. Plant lists are specific to Pennsylvania. 39 pages + appen-dices. Available from Pennsylvania Dept. of Environmental Protection, Bureau of Watershed Conservation, 717-787-5259. Free.

Pyle, Vic III, ed. **The Long Island Sound Conservation Blueprint.** Save the Sound, Inc. 1998. Stressing simple techniques that are practical for citizen groups, the Blueprint starts with the basics (What Is a Habitat? What Is an Estuary?) and proceeds to tips on building partnerships, finding funding, and obtaining permits. Provides general guidelines (but not detailed instructions) for coastal restoration techniques, including dune planting, fishway installation, and tidal wetland restoration. Very complete bibliography. About 200 pages, in looseleaf binder. $15 from Save the Sound, 185 Magee Ave., Stamford, CT 06902; 888-SAVE LIS.

A Citizen's Guide to Wetland Restoration. EPA Region 10. 1994. This booklet is aimed at laypeople, especially those with a wetland on their property. It provides guidance for simple, low-tech methods such as planting native plants and controlling nonnatives, enhancing wildlife habitat (e.g., installing nest boxes), and removing disturbances (e.g., fencing to restrict access by domestic animals). Includes a native plant guide for the Pacific Northwest. 71 pages. Free; order EPA #910-R-94-006 from EPA Region 10, 1200 6th Ave., Seattle, WA 98101; 206-553-1200.

Hellmund, Paul. **Planning Trails with Wildlife in Mind.** Colorado State Parks. 1998. Only recently have people begun to seriously consider the impacts of trails on plants and animals. This handbook provides many useful "rules of thumb" for those who may be constructing or rerouting a trail as part of a restoration project. 51 pages. For a copy, send SASE, 9x12, with 6 first-class stamps to Colorado State Parks'Trails Program, 1313 Sherman St., Room 618, Denver, CO 80203; or download from http://www.dnr.state.co.us/parks/. For multiple copies, call 303-866-3203 ext. 306.

Journal

Ecological Restoration/North America *(formerly Restoration and Management Notes).*
The remarkable thing about this journal is that the reader is as likely to encounter a reference to Prometheus or a quote from an anthropologist as a technical report on restoration methods. Recent articles have dealt with such diverse topics as germination of prairie seed, the debate over removing tamarisk (a nonnative shrub), and public attitudes about ecological restoration. Community-based restoration projects are a frequent feature. Each issue includes extensive abstracts and reviews of related publications and Websites.

To subscribe, contact Journal Division, Univ. of Wisconsin Press, 2537 Daniels St., Madison, WI 53718-6772; 608-224-3880. Individual subscriptions $29/year. (Or join the Society for Ecological Restoration (SER) and receive the journal as part of your membership. For information about SER, see Society for Ecological Restoration.)

Funding

Restore America's Estuaries**. Funding for Habitat Restoration Projects: A Compendium of Current Federal Programs.** 1998. Federal funding for restoration is scattered among different agencies and can be very hard to track down. This 42-page booklet organizes federal funding programs into an accessible reference guide. Includes useful comments on the extent to which each funding program supports habitat restoration projects. First copy free, additional copies $5; from RAE, 1200 New York Avenue, NW, Suite 400, Washington, DC 20005; 202-289-2379; or download from www.estuaries.org. (Note: An updated report should be posted on the Website by September.)

Background Information

Leopold, Luna B. **A View of the River.** 1994. Harvard University Press, Cambridge, MA.

Rosgen, David. **Applied River Morphology.** 1996. Wildland Hydrology, 1481 Stevens Lake Road, Pagosa Springs, CO 81147.

Gray, Donald H. and Robbin B. Sotir. **Biotechnical and Soil Bioengineering Slope Stabilization: A Practical Guide for Erosion Control.** 1996. John Wiley & Sons.

Kusler, Jon and Mary Kentula. **Wetland Creation and Restoration: The Status of the Science.** 1990. 616 pages. Island Press.

Videos

Urban Stream Restoration: A Video Tour of Ecological Restoration Techniques with Ann Riley. A 61-minute documentary about six urban stream restoration projects. It covers a variety of restoration techniques, including soil bioengineering, recreating stream shape, and daylighting creeks, and also discusses how communities were involved and where funding came from. $39.99 + $5 S&H from Nolte Media, 405-A West College Ave., Santa Rosa, CA 95401; ph. 707-579-3902; fax 707-544-0499.

Restoring America's Streams. Companion to IWLA's *Citizen's Streambank Restoration Handbook* (see above); explains stream processes and causes of stream instability, and demonstrates restoration techniques that use native vegetation. Includes several case studies. 28 minutes. $20 from Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD 20878; 800-BUG-IWLA.

Wetland Restoration: Steps to Success. Techniques for wetland restoration; includes use of native plants, and when and where to plant. 21 minutes. $20 from The Wetlands Conservancy, 503-691-1394.

Websites

- **http://www.epa.gov/owow/wetlands/restore/** . EPA's restoration Website includes information on 100+ projects from around the country, organized by state.

- **http://www.habitat-restoration.com** . Restoration bibliography, events listings, and organizations. Many links to other useful sites.

- **http://www.nmfs.gov/habitat/restoration/** . National Marine Fisheries Service (NMFS) Office of Habitat Restoration.

- **http://http://ser.org/.** Information about the Society for Ecological Restoration.

- **http://www.bioengineering.com.** Contains useful discussion of bioengineering and a bibliography of bioengineering publications.

- **http://www.wetlandtraining.com.** Lists professional training workshops offered by the Wetland Training Institute; topics include wetland construction and restoration, and riparian restoration.

Advisors and Reviewers Needed

The Izaak Walton League of America is planning a revision of its Citizen's Streambank Restoration Handbook and would welcome input from people who have worked with volunteers to carry out restoration projects using bioengineering techniques. Anyone who can offer advice or serve as a reviewer for the revised manual is invited to contact Julie Vincentz Middleton at 800-BUG-IWLA ext. 223 or 301-548-0150 ext. 223; email jvincent@iwla.org.

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Learning Science Through Restoration

by Jim Martin

The main questions I hear students ask at restoration plantings are "Where are the shovels?" and "Do we plant our tree here?"

Hmm. Could these projects be missing the "science" part of environmental science? Often they are. After the planting, students may become more aware and solicitous about the environment, but they don't necessarily understand it any better. Certainly schools and students are extensively involved in restoration plantings. Plantings are popular because they require little training, and they give students a chance to engage the environment, do constructive work, and discover the world as it exists. Restoration projects send a clear message: we, the people, made mistakes, have become aware of them, and are taking steps to make corrections. And to top it off, the endproduct is impressive.

But is this enough? Are our restoration plantings one-shot exercises, after which we go back to the "real" world, or are they part of an integrated experience that teaches us about the environments that we live in? Environmental education should be a journey, one that captures our interest and imagination and leaves us with the tools to become effective stewards of the place where we live.

Putting the science back in

Instead of a one-shot field trip, let your restoration plantings become part of an ongoing course of instruction. Organisms live in environments. Their biology, studied within the context of their environment, provides a coherent structure for environmental education.

Most plantings don't include studying the site's biology or soils upfront, nor do they provide for longitudinal monitoring after the planting is completed. Adding these elements to your project means you must start your study months in advance of the planting event, and continue for years afterward. A formidable challenge.

First, get your facts. You need to know about your plants and the soils they prefer. Organize the work around simple, categorical questions like, "In which soils do our plants grow best?" (A good scientific question should suggest a way to answer itself. Does this one?)

Consult reference books to find out what soil properties your plants prefer, then go to the restoration site and test the soils you find there. What do these tests tell you about the suitability of site soils for your intended plants? If you have time, do experiments--grow your plants in soil samples from the site and other soils you make up yourself.

After you have your facts about the plants and soils, make some predictions about the plants' survivability, then do the planting. And you've completed the hard part. The rest should be enjoyable and instructive.

You can make observations on plant vigor, diameter, height, root length, rates of growth, or internodal lengths (nodes are the places where leaves attach, and internodes are the spaces between nodes). Keep data records as part of a long-term monitoring plan.

After you plant an assemblage, ask how it will organize itself over time. Investigate this question by marking and mapping a study plot at your site. Identify each plant, or a random selection of plants, and measure height, diameter, percent cover, or other parameters that you think appropriate. What happens to the relative frequency of each species? Do all plants grow at the same rate? same time of year? Does this raise further questions? Just monitoring a planting for a few years will give you insights into how environments come to be, and why some organisms live in one particular environment and not others.

A restoration project gives students lots of chances to practice communication. Since monitoring continues over many years, each class must figure out how to pass on what they've learned and observed to future classes. Save posters, data sheets, and reports and introduce them to next year's class as a valuable resource they can use to enhance their own work. Ask them for feedback about what was useful and what else would have

been helpful to communicate. Give the new class a sense of history--and something to shoot for during their tenure.

Structure next year's work around the gaps left by this year's work. This is how science is done, one piece of the puzzle at a time. A good concept for all of us to learn, because life is lived in the same way. It's not instantaneous, but the process develops clear sets of connected facts.

Students at a tree-planting on Brush Creek in Santa Rosa, California.

And if you do your work right, at some future restoration planting you just might be rewarded by hearing a student ask, "What makes cottonwoods live here?" or "What's in the food web of this dune grass?" or "How many of these wetland plants will still be alive next year?"

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Note: A longer version of this article appeared in the Spring 1999 issue of Clearing: Environmental Education in the Pacific Northwest. To subscribe to Clearing (4 issues/$18) contact E.L.C., 19600 S. Molalla Ave., Oregon City, OR 97045; clearing@teleport.com.

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Assessing Restoration in Four Dimensions

by William R. Jordan III

When restorationists talk about assessing the quality of a restoration project, they're usually thinking about the quality of the product. Accordingly, they ask questions about the ecological accuracy or authenticity of the restored ecosystem--whether it looks and behaves like the model system.

The value of the product is obvious. But a restoration project has other dimensions of value, and they are generally less obvious--at least from a modern perspective. I have come to think of these in terms of four dimensions of value--in addition to product, these are process, experience, and performance.

Perhaps what we need then is a checklist of questions to use in appraising our efforts in each dimension--something like this:

1. The product. Is the restored system ecologically accurate--that is, faithful to the model system with respect to functions and dynamics as well as composition and structure?

2. The process. Did we give everyone with an interest in the project a chance to participate? Did we take advantage of all the opportunities to conduct research and gain knowledge? Did we raise questions and test ideas about the ecosystem being restored, about human relations with it, and about the restoration techniques used?

3. The experience. For the participants, was the project an occasion for learning and for emotional and spiritual bonding with the landscape? Did the work take advantage of restoration as a way to explore various kinds of relationships with the landscape and to exercise a wide range of human abilities and interests?

4. The performance. What did we do to enhance the value of the work as an expressive act, or to develop it as a ritual for celebrating our relationship with the larger biotic community? What information, ideas, values, and feelings did we convey to people who were not directly involved in the project but who could benefit from it as an audience?

(Excerpted and adapted from "Good Restoration" in Restoration and Management Notes 13:1, Summer 1995.)

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Frogwatch USA

Frogwatch USA, recently launched by the U.S. Geological Survey, is a frog and toad monitoring program designed for broad public participation. Participants choose a wetland to monitor, then periodically visit it at dusk and listen for calling frogs and toads. They can mail their results to the Frogwatch office or submit them directly to the Website.

Frogwatch's research goals include tracking frog populations at discrete wetlands, documenting when each species begins and ends its breeding season in different regions, and gathering information on species distribution. In addition, Frogwatch gets the public involved in amphibian research and helps people learn about ecosystems.

Frogwatch is separate from, but complementary to, the North American Amphibian Monitoring Program (NAAMP). NAAMP is designed for trend analysis on a larger scale and is more scientifically rigorous-- for example, monitoring routes are assigned according to a randomized design, and more training is required for volunteers. (For more on NAAMP, see *The Volunteer Monitor*, Spring 1998, "Amphibian Decline: Monitors Search for Answers.")

For more information, or to sign up as a volunteer, just go to the Frogwatch USA Website at www.mp2-pwrc.usgs.gov/Frogwatch/, or contact Frogwatch Coordinator, Patuxent Wildlife Research Center, USGS-BRD, 12100 Beech Forest Rd., Laurel, MD 20708-4038; 301-497-5819.

EPA Environmental Education Grants

EPA's environmental education program annually awards grants to states, nonprofit groups, and tribal organizations to support environmental education projects. A number of volunteer monitoring programs have benefited from these grants in the past.

The application process is very competitive. Only 15 to 20 percent of applications are funded. Your best chance is to apply for a grant of $5,000 or less. Grants under $25,000 are awarded by the EPA regional offices; grants for over $25,000 are awarded by the EPA's Washington, DC, Environmental Education Office.

The deadline for grant applications is usually in mid-November. Check EPA's environmental education Website (http://www.epa.gov/enviroed/grants.html) in September for the exact date. The Website also provides tips for successful grant applications. For more help, see EPA Region 5's environmental education grant page at http://www.epa.gov/region5/enved/grants.html, which offers grant writing tutorial software and examples of past proposals that were funded. (If you don't have Web access, call EPA's grants line at 202-260-8619; leave a message and you will be called back.)

Great American Fish Count

Each year, during the first two weeks of July, volunteer divers and snorkelers take part in a fish census known as the Great American Fish Count. The event began in 1992 with just 50 divers. Last year, hundreds of divers participated in California, Florida, Georgia, Texas, and the Pacific Northwest.

Before conducting a survey, volunteers are strongly encouraged to attend a free training seminar to learn fish identification skills. (Seminars are offered in many locations around the country; see the Website, below, for details.) For the Fish Count, divers use a special datasheet to record all species they can positively identify within 100 meters of where they enter the water.

Brian Huff, coordinator of the Fish Count, says that one of the project's major goals is to encourage more divers to get involved in long-term, year-round monitoring. Ongoing monitoring provides the most valuable data for tracking fish populations.

The Great American Fish Count is a joint project of the American Oceans Campaign, Reef Environmental Education Foundation (REEF), and the National Marine Sanctuary Program.

For more information, visit http://www.fishcount.org or call 800-8ocean0.