United States
Environmental
Protection Agency

Office of Water, Office of Wetlands,
Oceans and Watersheds
Washington DC 20460

EPA 843-B-00-001
December 2001

VOLUNTEER WETLAND MONITORING

An Introduction and Resource Guide

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COVER: *Three common "arrow" wetland plants: duck-potato* (Sagittaria latifolia)*, arrow-arum* (Peltandra virginica)*, and pickerel weed* (Pontedaria cordata).

Preferred Citation:
USEPA. 2000. *Volunteer Wetland Monitoring: An Introduction and Resource Guide.* EPA 843-B-00-001. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Wetlands Division, Washington, DC.

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Note to the Reader

This document is intended to provide individuals and organizations an introduction to why and how people monitor wetlands and to briefly describe a few of the handbooks and manuals that offer detailed information on wetland monitoring for the layperson. We also offer some advice on approaching wetland monitoring, most of which is a synthesis of comments we have received from organizers of volunteer wetland monitoring programs across the United States.

The U.S. Environmental Protection Agency (EPA) Office of Wetlands, Oceans, and Watersheds encourages community involvement in water resource activities and decision-making processes. The office has published manuals for volunteer monitoring of lakes, streams, and estuaries and plans to eventually publish a series of manuals for citizen wetland monitoring. For a variety of reasons, the time is not yet ripe to publish such manuals for wetlands. First, wetland ecology has not yet advanced to a stage where scientists agree on the best measurable indicators of wetland health. EPA is currently working with its partners in the scientific community on these indicators (as well as sampling protocols and analytical tools). Second, wetlands vary so much from region to region and from type to type that any future EPA citizen wetland monitoring manual will have to deal innovatively with this great variety. We are exploring the idea of publishing regional manuals or, alternatively, manuals that correspond to different wetland classes.

Pending the development of agreed-upon indicators and the design of a more complete citizen wetland monitoring guidance, we are providing a guide based on the most informative and useful wetland monitoring manuals we have found. We also document some important observations on volunteer monitoring strategies that appear most effective at assessing and protecting our nation's wetlands.

Acknowledgments

Extensive consultation with Neal Maine of the Oregon Wetlands Study, Chris Swarth and Judy Burke of Jug Bay Wetlands Sanctuary in Maryland, and Mitch Keiller of the State of Maryland helped to shape the content of this document.

The NOAA Sea Grant Fellowship enabled Matthew Witten to spend the year of 1997 working in the area of volunteer wetland monitoring at the EPA Wetlands Division in Washington, DC. Subsequently, EPA provided Witten with assistance funding through the Environmental Careers Organization. These programs enabled him to contribute to the scope and content of this document, as well as other volunteer wetland monitoring activities.

Reviewers from the EPA Wetlands Division, EPA Region 10, EPA Assessment and Watershed Protection Division, Professor of Fisheries and Zoology James Karr at the University of Washington, Faculty Research Assistant Paul Adamus at Oregon State University, and Eleanor Ely, editor of *The Volunteer Monitor* newsletter, contributed invaluably to the scope and content of this document.

Illustrations were provided by Thomas J. Danielson.

SECTION A

Introduction to Volunteer Wetland Monitoring

Five-lined skink *(Eumeses fasciatus)*

Why Wetlands?

Wetlands were maligned for many generations as mucky, buggy, disease-ridden mires. Wetlands may still be a nuisance or barrier to some people, but society now recognizes wetlands for their unique and highly valuable qualities. Wetlands provide rich habitat for plants, invertebrates, fish, reptiles, birds, and mammals. Coastal, riverside, and lakeside marshes are major nurseries for many of the fish that humans and other animals eat. Isolated wetlands provide critical stopover points for migrating birds and breeding grounds for amphibians. Bogs, which are naturally acidic environments, host magnificent plants such as the pitcher plant and the sundew (both insect-eating plants).

Zebra swallowtail *(Eurytides marcellus)* perched on a pawpaw *(Asimina triloba)*

In addition to valuing these biological attributes, people are coming to recognize wetlands for the important physical and chemical functions they perform. For decades, flood control engineering consisted of straightening river channels and building levees, but engineers now understand that one of the most effective ways to control floodwaters is to maintain riparian and floodplain wetlands. These wetlands act as sponges by retaining, slowing, and absorbing excess rainfall and over-bank flows during storms. During dry seasons and droughts, wetlands gradually release water to subsurface recharge areas and help keep streams from drying up.

Before Europeans settled the United States, wetland and riparian plants in North America provided the resources to meet the subsistence, construction, and medicinal needs of native peoples in the Americas. For example, wetland plants such as wapato, cattail, camas, and clover served as important sources of food. Sedges, rushes or tule, cattail, cedar, and spruce root provided critical materials for basket weaving. Other species were used to make fishing nets,

clothing, and other cord and rope products. Nutritional supplements and medicinal plants were also tended and harvested from wetlands throughout the Americas. These traditional uses continue to be important wetland functions today.

Wetlands can also help preserve water quality. As wetlands absorb storm water, their copious grasses, sedges, rushes, shrubs, and other forms of vegetation help filter sediments and pollutants out of the runoff water. In this way, wetlands purify ground water and surface water, resources critical to humans.

Now that society has acknowledged the profound value of wetlands, we are proceeding with the tasks of protecting and restoring them. In a world of multiple interests and needs, wetland protection and restoration confronts debate, financial constraints, and often incomplete information. Wetland scientists still have a great deal to learn about how wetlands work, and citizens and their various levels of government have much to learn about what wetlands are and how to deal with them. We are just beginning to answer some of the basic questions about wetlands. Citizen volunteers can help!

We are just beginning to answer some of the basic questions about wetlands.

Why Volunteer Monitoring Is Important

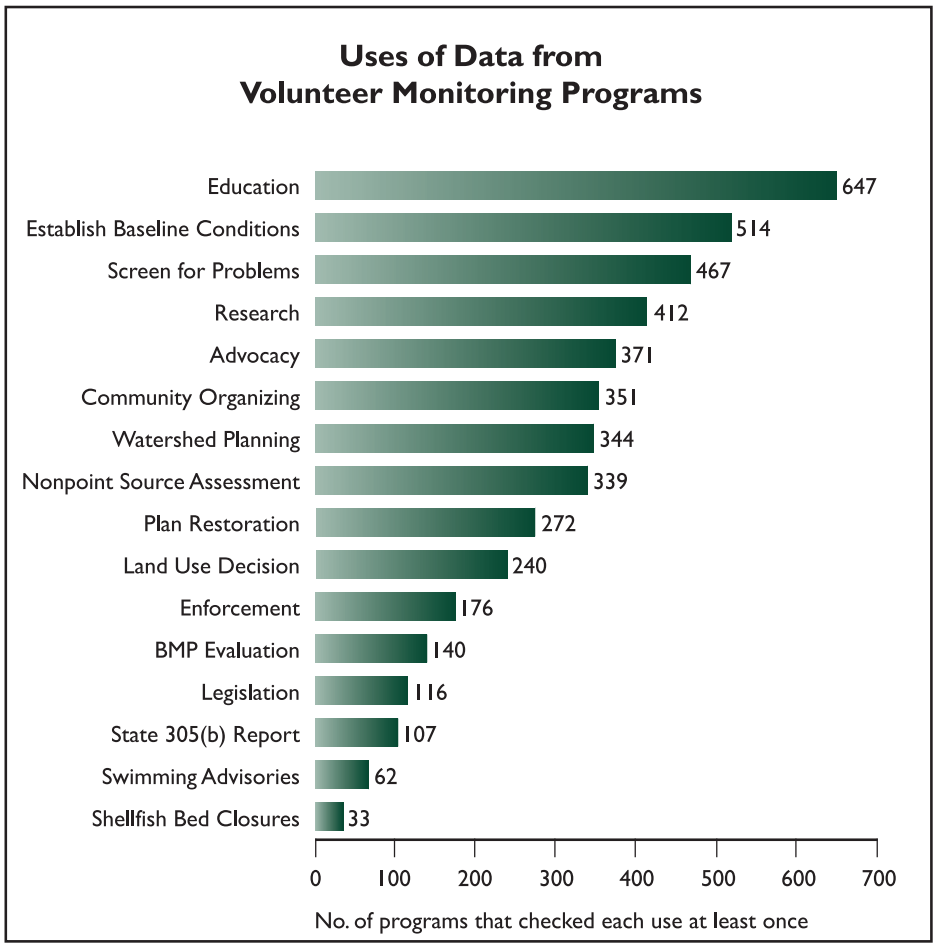
Volunteer monitoring is a long-standing tradition in the United States and other countries. Some of the best established types of monitoring are bird surveys and weather watching. Bird surveys have helped to document the connection between declining numbers of migratory songbirds and declining forest habitats in North, Central, and South America. This evidence has contributed to an international campaign to preserve forested wetlands. Volunteer weather reporting aids meteorologists in their forecasts, which can help protect crops, homes, and human lives.

In the past two decades, water quality monitoring has become a major force in protecting and restoring water bodies and watersheds. About half the states in the United States have hired staff to provide training and to manage,

sponsor, and support volunteer work. In every state there are some volunteer monitoring efforts, coordinated either by the states or by non-governmental organizations. The data volunteers collect are used for problem screening, baseline assessments, watershed planning, education, and many other uses.

The graph on this page illustrates both the array and extent of volunteer monitoring data use.

In the 1998 *National Directory of Volunteer Environmental Monitoring Programs* (EPA 841-B-98-009), there are 772 volunteer monitoring groups listed.



Ely and Hamingson, 1998.

The groups represent hundreds of thousands of volunteers in monitoring lakes, rivers, streams, wetlands, estuaries, and beaches. Volunteer monitoring groups observe and measure dozens of parameters, which range from water temperature, dissolved oxygen, and macroinvertebrates (some of the most common) to phytoplankton, construction sites, and pesticides (some of the least common).

"Screening" is one of the most important roles that volunteer wetland monitoring can play in ecosystem conservation. A screening is an initial assessment that indicates areas in need of remedial action or greater study. During screenings, volunteers might collect information on exotic species invasion or water depth. Screenings by volunteers are not as detailed or as finely tuned as professional studies, but they can provide basic assessment information on a large number of wetlands or other water bodies. In the past few years, preliminary information collected by volunteer wetland monitoring projects in several parts of the United States has clearly indicated the need for further study by qualified scientists. This was the case with the discovery of frog deformities by volunteers in the Midwest and other places in the country, a wetland phenomenon that has drawn the attention of a large number of federal, state, and university scientists.

Although we do not know the exact causes of these deformities in amphibians, some of the possible causes include chemical runoff from adjacent lands (e.g., pesticides and herbicides), increases in ultraviolet radiation caused by ozone layer depletion, parasites, and acidification from carbon dioxide emissions. Trends in the decline or disappearance of amphibians are also important to monitor. Amphibian declines may be due to factors that alter or destroy wetlands such as development within the watershed.

As government agencies and conservation organizations have recognized the need to characterize and monitor the health of wetlands, volunteers have become an important community resource. Government funds alone cannot support monitoring for the millions of acres of wetlands across the landscape. In many states, state agencies have used the data generated by volunteers to meet reporting requirements, inform management decisions, and assess

Wetland parameters often measured by volunteers:

Dominant vegetation type. This measurement, which requires some training, is often conducted using sample plots located on transects and is a principal means of detecting change in a wetland.

***Adjacent impervious surface* (e.g., pavement, roofs).** This can be estimated using maps or visual observations in the field and can be an important indicator of stresses to wetlands.

Hydrology. The timing, frequency, and duration of water inputs can be critical to wetland health. Water fluctuations can be measured in many wetlands, and the observation of human-built tidal restrictions (in coastal wetlands) can uncover potential impacts on tidal marshes.

Exotic plant species encroachment. This measurement uses some of the same methods used for measuring dominant vegetation types and can point to the need for eradication of exotic species.

Amphibian migration counts. A variety of methods are used to count amphibians, all of which require training and supervision. Amphibian counts can provide insight into the effects that land use or other stressors might have on wetland health.

Macroinvertebrate taxa richness. Macroinvertebrate monitoring takes considerable training, but data on this taxa have been tested for many years, especially in streams. The presence or absence of certain macroinvertebrate taxa can provide strong indications of wetland quality.

***Physical and chemical baseline parameters* (e.g., temperature, pH, turbidity).** These are very common measurements and can provide valuable data that may correlate to other parameters.

Bird sightings. Recognizing and counting birds and their calls takes training and can be a good screening mechanism in assessing risk or determining a wetland's connection to migratory corridors.

***Wetland appearance/footprint* (through photographs or maps).** This very simple information-gathering method is not scientifically rigorous but can help supplement other data and "freeze" a picture of a wetland's condition at a certain time.

Underlying drawing: Wild lupine (Lupinus perennis)

Data collected by more than 1,500 LakeWatch volunteers in the mid-1990s have been used by Florida LakeWatch to modify Florida water quality standards for lakes. The 3-year Florida Lake Regions Project, completed in 1997, documented correlations between parameters measured by volunteers (including total phosphorus, nitrogen, and turbidity) and the regional soils and bedrock geology of approximately 600 lakes. These data helped state officials confirm that lake phosphorus chemistry varies according to underlying geology and that different water quality standards need to be established for lakes in different regions of Florida. As a result, lakes in regions with high levels of naturally occurring phosphorus will be managed at different trophic levels from lakes that are naturally clearer and less eutrophic. (Hoyer, 1999.)

various impacts. The examples on this and following pages offer some of the many ways volunteer monitoring data has been used to inform various kinds of water resource management decisions.

Volunteer monitoring programs are also important for fostering stewardship among participants. People who monitor wetlands become more intimately knowledgeable about the place in which they live and the ecological processes that influence it. Volunteer monitoring can create informed and knowledgeable citizens who become better stewards and advocates for more sustainable approaches to land use and water management.

Monitoring Wetlands

Wetland monitoring often includes some of the same sampling practices common to lakes and rivers (e.g., acidity and dissolved oxygen; benthic macroinvertebrates such as mayflies, snails, and worms; and submerged or floating plants such as algae). Unlike much of the monitoring in lakes and rivers, however, an assessment of wetland conditions can also parallel monitoring or assessment techniques that would be used in a forest, meadow, or other upland area. For example:

- One method to survey adult frogs and salamanders is to install drift fences and pitfall traps on land.

- One method to measure the abundance or distribution of vegetation is to outline plots along transects and document the number of plants in a given sample area.
- One method to determine the influence of water in the soil is to dig pits and evaluate them for signs of chemical processes created by the fluctuation or periodic presence of water.

Northern pitcher-plant *(Sarracenia purpurea)*

Wetlands require a broad spectrum of surveying and monitoring techniques because they are the interface between land and water and because they exist in a great variety of forms. The term "wetland" applies to saltwater marshes on the coast, acidic bogs in boreal forests, cypress swamps on coastal plains in the south, and bottom-

In 1996 the State of New York required the Syracuse International Airport to treat its runoff discharge to a nearby stream, partly because of monitoring efforts by nearby volunteers and high school students. As part of the Izaak Walton League's Stream Doctor project, volunteers began monitoring Beartrap Creek in 1991, and the students joined in 1994. Volunteers found that glycols and other deicing materials from the airport were entering the former trout stream through rain and snowmelt runoff, reducing dissolved oxygen levels in the stream and negatively affecting the macroinvertebrate community. The volunteers alerted the New York State Department of Environmental Conservation, which required the airport to build a runoff treatment facility. Volunteer monitors have since found that water quality has improved and more pollution-sensitive macroinvertebrate species have appeared. (Urban Stream Doctors in New York, 1998.)

In 1985-1986 on Whites Creek (Tennessee), Izaak Walton League volunteer water monitors' observations of siltation and measurements of benthic macroinvertebrates figured significantly in legal proceedings that led to an agreement aimed at reducing impacts from erosion and other construction-related effects. The State Department of Transportation agreed that in the future it would apply to the Department of Health and Environment for a water quality permit for construction projects affecting Tennessee waters (Norris, 1992).

land hardwood forests in floodplains. Each wetland type hosts a distinct community of flora and fauna. For example, bogs, where peat accumulates over long periods of time, create a highly acidic environment to which only a limited number of plants and animals have adapted. In salt marshes an entirely different assemblage of specialized plants and animals has adapted to the stresses of salt and fluctuating water levels. Wetlands such as vernal pools, which often dry up in summer, have unique physical conditions, thereby hosting yet other assemblages of plants and animals.

Wetlands require a broad spectrum of surveying and monitoring techniques because they consist of both land and water and present a tremendous variety of forms.

The large diversity of wetland types has led to a lack of uniformity in the sampling techniques, tests, indicators, and analytical methods used by scientists to understand them. EPA is part of a partnership to improve the quality of wetland monitoring. These efforts will result in improving indicators for assessing the health of the various wetland types that occur in the United States.

Because physical and chemical conditions create such a variety of biological conditions in wetlands, measurements of pH, dissolved oxygen, and total

suspended solids give a limited picture of a wetland's health. It is valuable to look at the plants and animals themselves to gain insight into the ecological functioning and biological condition or integrity of wetlands. Biological integrity is the ability to support and maintain a balanced, integrated, adaptive biological system with the full range of elements and processes expected in a region's natural habitat (Bartoldus, 1999).

Scientists can use bioassessment methods to directly measure the biological condition of wetlands and determine if they have been damaged by human activities. If a state, tribe, or other organization detects a warning signal during the screening process, they can conduct a more detailed and thorough assessment. Many states using bioassessment methods for streams are finding that they can save time and resources by screening a large number of sites with "rapid bioassessments" and then following up with more detailed assessments, including expensive chemical and physical tests when appropriate.

Bioassessment can also be used to determine if a wetland has been damaged by human activities. By observing the presence, absence, or relative proportions of indicator plant and animal species, scientists can analyze the health of a wetland. Indicator species are those that react predictably to natural conditions and/or human impacts. For example, a dominance of filamentous green algae in a freshwater marsh might indicate human-influenced nutrient enrichment of the watershed, whereas a diversity of sedges and rushes (grass-like plants that compete well in wet places) might indicate relatively unimpaired conditions. Typically, these biological assessments combine several measurements or metrics to derive a robust picture of wetland health sometimes presented as an Index of Biological Integrity (IBI). For more information about wetland biological assessment, see EPA's web page at www.epa.gov/owow/wetlands/bawwg.

In addition, wetland bioassessment is useful in helping to protect and restore wetlands, evaluating the performance of

protection and restoration activities, and developing watershed management plans. The information provided by biological assessments can help agencies prioritize and target activities to protect and restore wetlands. Also, by periodically conducting bioassessments, states and tribes can track the condition of wetlands and learn which management activities have worked as planned and which have not. With this knowledge, states, tribes, and land use managers can improve future management plans and maximize their wetland protection efforts.

NOTES

SECTION B

Designing a Wetland Study

Pink lady's slipper *(Cypripedium acaule)*

C A U T I O N !

- **Always** contact the landowner before entering a wetland (whether privately or publicly owned). **Never enter a wetland without the landowner's permission.**

- **Minimize your impact on the wetland you are observing, surveying, or sampling.** This may mean limiting the number of people entering the wetland, choosing a single path to follow to avoid trampling a wider area, or perhaps choosing another strategy because well-worn paths can become ditches. Minimizing impact may mean not even entering the wetland at all. There are several surveying techniques that do not involve entering the wetland under study.

- **Clean equipment and boots after visiting each site.** This practice will avoid transporting plant seeds and introducing them to other wetlands. The spread of invasive species has become one of the top threats to wetlands and other ecosystems.

- **Begin taking samples of plants or animals only after you consult with a wetland scientist.** Some wetlands may pose dangers to you, and you may pose dangers to certain wetlands, especially if they contain **threatened or endangered species**. When you are in the field, be cautious. Ask a biologist or wetland ecologist to examine your site before you take any samples of plants or animals.

- **Some wetlands are so ecologically fragile or valuable that volunteers should not enter**. This is another reason it is essential to check with landowners and knowledgeable scientists before monitoring a wetland.

- **Your organization should have some coverage for liability and for possible injuries.** There are many options for doing this, including covering volunteers with workers' compensation (available only in some states) or obtaining insurance through funding agencies or other partners. For more information, see "Are You Covered?" in *The Volunteer Monitor* newsletter, Spring 1996, pages 22-23. Prevention is the key to reducing the risk of injury and lawsuit. Therefore, **observe all safety precautions and train volunteers thoroughly to reduce the risk of injury**. Volunteers should never put themselves at risk to obtain a measurement or observation.

Narrowing Parameters

Volunteer wetland monitoring is as much an educational activity as a research activity, and conveying "the big picture" to volunteers is certainly a priority. It may be a disservice to volunteers to ask them to measure something about wetlands—whether it be salinity, macroinvertebrate species abundances, or vegetation densities—without first teaching them how each parameter has significance for the wetland. It is a good idea to give volunteers an orientation on how wetlands function and how their physical, chemical, and biological elements interact. In short, volunteers will want to know some wetland ecology. This knowledge will not only make them better researchers, but will also heighten their interest.

Left: Prairie warbler (*Dendroica discolor*)
Right: Parula warbler (*Parula americana*)

However, most people who have worked with volunteer wetland groups agree narrowing the measurements volunteers are asked to take is a key factor in obtaining good data and holding volunteers' interest. For example, the Maine Audubon Society (whose manual is listed and annotated in Section C) originally planned for its volunteers to do seven assessments of tidal salt marshes, ranging from ecological integrity to educational potential of the marshes. Each of the seven assessments included a number of measurements or observations. After conducting workshops and assessments with volunteers, the organization realized that volunteer efforts would be

more sustainable and effective if volunteers were asked to do a single assessment (tidal restrictions) involving two observations and one measurement at each site.

When volunteers can focus on only a few measurements and observations, the task is easier for them to grasp and they are less likely to become frustrated. Also, when volunteers specialize in a task, they can practice and develop the competence that will give them pride in their work. As their competence and confidence build, certain individuals may become ready to take on other tasks.

Balancing Education and Reliable Data

Ideally, all volunteer wetland monitoring programs will generate data that can be used by governmental or non-governmental agencies to protect and manage wetland resources. Generating such data is a worthy goal. However, it is best to exercise caution in choosing your area of emphasis when training volunteers to go into the field. It may be as important to develop volunteers' awareness of wetland functions and values, as to collect scientifically verifiable data. In either case, the stewardship ethic that wetland monitoring can engender is of tremendous benefit.

Some groups will be able to quickly produce reliable data, but other groups might have to practice for months or longer before they reach that point. Third graders in Calvert County, Maryland, are helping to monitor the movement and abundance of amphibians during the spring and fall. Data from their monitoring effort are being used by a county agency whose professional staff is on-site. Although this project has been able to put student data to use fairly quickly, in other situations data generated by this kind of group might have only limited use. An organizer should discuss with wetland specialists, scientists, and science teachers what amount of reliable data can realistically result from a particular group's monitoring efforts.

It often takes some time before a volunteer monitoring group graduates from monitoring for the sake of learning or training to monitoring to produce reliable data.

Over time, consider revising expectations about the credibility of the data generated. It often takes some time before a volunteer monitoring group graduates from monitoring for the sake of learning or training to monitoring to produce reliable data.

The Long-Term View

Unless your situation is unusual (e.g., using a team of retired biologists to spend one season assessing the dominance of plant species in a series of wetlands), it is likely that you will need to make a long-term commitment to building a volunteer base to achieve reliable results from monitoring wetlands. Volunteers tend to come and go because few people make long-term commitments to activities that do not offer pay. This is one reason that loyalty needs to be cultivated, and, like any club or group of friends, this takes time to develop. Eventually, you can develop a core group of volunteers who will attract others through their enthusiasm and dedication.

A long-term commitment will also help prepare your organization for the inevitable costs of sustaining a volunteer wetland monitoring program. Training sessions demand staff time for logistics, teaching, and field work. A program will be sustainable only if the monitoring organization provides or hires a volunteer coordinator. You will also need to spend money on food, training facilities, transportation, and equipment to develop rapport with a group of volunteers. It is probably unwise to spend money and time on involving volunteers for only a season or two; however, a long-term program makes these investments worthwhile. Furthermore, funding agencies are more likely to provide funds to organizations that show a long-term commitment to volunteer monitoring.

Quality Assurance

The first step in making sure monitoring data will be of some use to the public is establishing a Quality Assurance Project Plan (QAPP). A QAPP is a written document that outlines the procedures a monitoring project will use to ensure that the samples participants collect and analyze, the data they store and manage, and the reports they write are of high enough quality to meet project needs.

photo credit: Anna Hicks

Estuarine habitat assessment instruction.

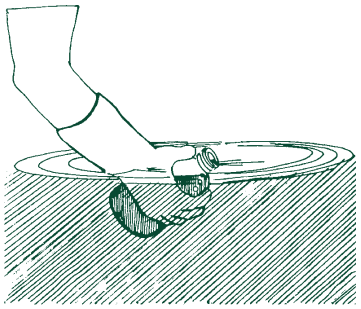
EPA-funded monitoring programs must have an EPA-approved QAPP before sample collection begins. However, even programs that do not receive EPA money should consider developing a QAPP, especially if state, federal, or local resource managers might use the data. A QAPP helps the data user and monitoring project leaders ensure that the collected data meet their needs and that the quality control steps needed to verify the data's usefulness are built into the project from the beginning. The steps recommended for developing a QAPP are outlined in the EPA publication *The Volunteer Monitor's Guide to Quality Assurance Project Plans* (see "Additional Resources" in Section C).

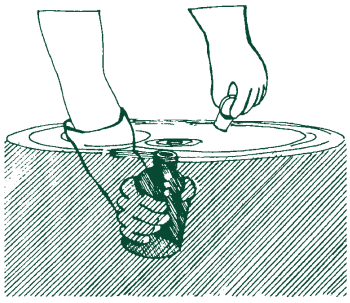
Data-oriented volunteer projects must continuously deal with the issue of credibility. Project leaders must be able to demonstrate to skeptics that the data collected by their volunteers are

- Consistent over time.
- Collected and analyzed using standardized and acceptable techniques.
- Comparable with data collected in other assessments using the same methods.

These project leaders must adopt protocols that are straightforward enough for volunteers to master, yet sophisticated enough to generate data of value to resource managers.

This cannot be accomplished without a quality assurance plan that details standard operating procedures in the field and lab, outlines the project





A monitoring project needs a quality assurance plan.

organization, and addresses issues such as training requirements, instrument calibration, and internal checks on how data are collected, analyzed, and reported. Just how detailed such a plan needs to be depends largely on the goals of the project.

Collecting Useful Data

If you want your data to be useful, it is important to find out how it will be used before you start generating the data.

Although there is validity to collecting "baseline data" on wetlands, any observations or measurements you make will be more useful if they have a clearly identified purpose. Collecting information for the sake of collecting information is not likely to be very productive.

The first step in beginning a monitoring program is to network in your community with the people and organizations that need information about wetlands or are interested in maintaining clean water supplies. Your group might determine the end use for the data, such as identifying better wetland protection measures or obtaining information on wetland functions that may change over time as a local watershed develops. Factual data on wetland conditions can be very important in bringing attention to the need to protect wetlands from various land use pressures.

Contact other organizations (e.g., drinking water utilities, recreation groups) and agencies in the community to offer them the data your citizen group collects. Although volunteer monitoring data may not be viewed by some as credible, volunteer monitoring data will in fact be both defensible and

more highly regarded if you demonstrate that the right quality assurance and quality control (QA/QC) procedures are in place to validate your data.

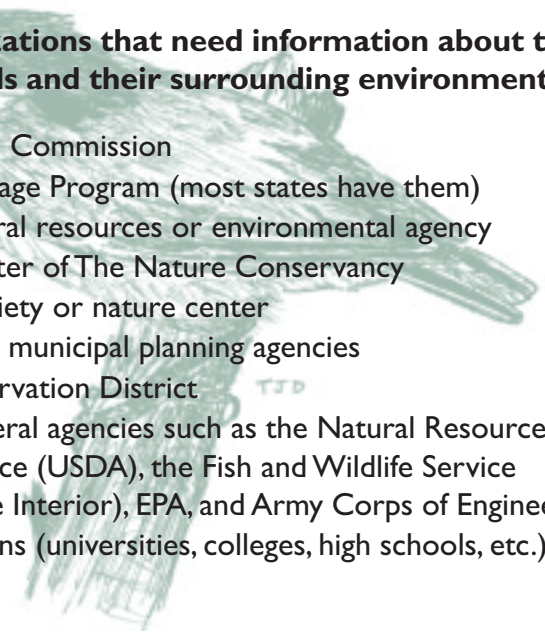
Collaborating with other groups or agencies can have many benefits. Such a link will give your monitoring efforts purpose and focus. When volunteers know of an organization that needs their work, they will probably be more motivated to do high-quality and sustained monitoring. Also, linking up with an agency or conservation group will give you access to resources such as technical expertise, specific wetland sites, and possibly funding. You may find, however, that the only organization in your community with the will and the resources to make use of wetland monitoring data is your own.

It will become clear over time which measurements are essential and may need especially close scrutiny and which are less vital and therefore need less scrutiny or can be dropped altogether.

Consider how collected data will be stored (usually in computer files with adequate backup), analyzed, and reported to the public or to other specific entities.

Examples of organizations that need information about the condition of wetlands and their surrounding environment:

- Local Conservation Commission
- State Natural Heritage Program (most states have them)
- State or tribal natural resources or environmental agency
- Local or state chapter of The Nature Conservancy
- Local Audubon Society or nature center
- Regional, county, or municipal planning agencies
- Local Water Conservation District
- Local offices of federal agencies such as the Natural Resources Conservation Service (USDA), the Fish and Wildlife Service (Department of the Interior), EPA, and Army Corps of Engineers
- Academic institutions (universities, colleges, high schools, etc.)



Underlying drawing: Brown-headed nuthatch (*Sitta pusilla*)

photo credit: Dave Davis

Beaver Dam, Rocky Mountain National Park.

Data entry and analysis are steps that are sometimes overlooked in the process of monitoring and communicating results. These vital steps do, however, take a considerable amount of time and energy and require some expertise as well. If data entry and analysis are not done with forethought and care, volunteer monitoring results might not be as clear or convincing as they could be.

One of the principal advantages to collaborating with another group or agency on the use for wetland monitoring data is that you stay abreast of the changing needs for different kinds of monitoring. The information agencies need is not necessarily static. As new questions arise and as political, social, and fiscal priorities change, so do priorities for all sorts of research, including wetland research. For example, if your state should pass legislation establishing grants for reducing the impacts of storm water runoff on natural systems, monitoring wetland sedimentation and its effects on biota might become a higher priority than monitoring the encroachment of exotic plant species. Monitoring is always more useful when it occurs over

a sustained period of time. Therefore, it is usually best to choose a monitoring strategy and stay with it. Compromises between strategies, however, may be necessary.

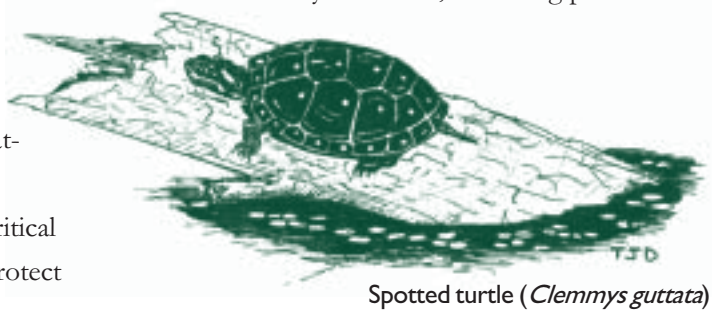
Monitoring is always more useful when it occurs over a sustained period of time.

Formulating Research Questions

Once you find a destination and purpose for your monitoring work, formulate and refine your research questions. Asking the right question is a key element in finding a useful answer. Great care must be taken to ask the right questions. Otherwise, midway into a monitoring program, researchers may find that they have collected information that will not address the original monitoring needs.

Asking the right question is a key element in finding a useful answer.

Although formulating a research question can be critical to using data to protect wetlands, it is normal for even the best scientists to revise their questions and hypotheses as they make observations. Expect to start with one question or hypothesis that will evolve into another, making sure to document the new hypotheses and the steps that led to them. Often, when we look at a wetland, we think we have a good idea of what characteristics will be most salient in determining its health. "This wetland should have a healthy amphibian population" or "This wetland has been impaired by sedimentation" are statements that would lead researchers to focus on certain parameters. It may be that after wetland characteristics such as sedimentation or the presence of amphibians are studied for a year or two, no strong pattern



Spotted turtle (*Clemmys guttata*)

emerges. However, other significant characteristics might surface.

Finding Your Niche

It is important to know where your wetland monitoring programs fall on the spectrum of scientific rigor. In other words, are you trying to generate data rigorous enough to stand up to the peer review of professional scientists and perhaps stand up in a court of law or do you intend to generate data meant as a rough screening mechanism? There are advantages and disadvantages to each of these strategies. The important point is that your organization have clearly formulated, written goals and expectations regarding scientific rigor.

The important point is for your organization to have a clear idea of its goals and expectations regarding scientific rigor.

You might not find your niche until you have worked with your volunteers for a season or two. For example, at the outset of your wetland monitoring program, perhaps your expectations are low and you hope to train volunteers to do rough preliminary surveys of wildlife in certain wetlands. If it turns out, however, that your community includes avid wildlife trackers or bird watchers who want to put their skills to good use, you might be ready to provide systematic, highly credible wetland wildlife data to relevant agencies in a short period of time.

On the other hand, you might set expectations high if you anticipate having graduate students working with you. These expectations may have to be revised if you actually recruit only one relatively inexperienced graduate student supervising a volunteer workforce of first-year environmental studies undergraduates. In such a case, the quality of the generated wetland data might be somewhat low, especially since you would have turnover each semester. However, the education and enthusiasm that university students provide might be just as valuable as the credible data generated by experienced trackers and birders.

There could be a number of purposes for making observations of wetland characteristics and taking measurements of wetland attributes. Sometimes called "research objectives," some of the most common purposes are to:

- Determine whether a "restored" wetland is truly meeting the goals of the restoration plan or permit.
- Reveal trends in wetland health (improvement or decline), to ensure appropriate watershed development and management decisions.
- Correlate wetland conditions with land use practices to determine if some of these practices need to be continued, modified, or halted.
- Provide evidence that a particular wetland has important values to society and therefore should be protected or perhaps acquired publicly.
- Characterize natural, relatively undisturbed wetlands, often called "reference" sites, to serve as models for the restoration of disturbed wetlands.
- Obtain information that can be used to assess the functioning of the wetland system.
- Present facts at public hearings about the plants within and the animals using particular wetlands in order to provide educated comments on environmental review documents or proposed permit actions.
- Educate members of the community about wetlands, fostering hands-on experience in natural areas through seasonal and annual cycles.

Underlying drawing: Clapper rail (*Rallus longirostris*)

How the Resource Guide Can Help

The resources described in the next section of this guide will give you a sense of which manuals are scientifically rigorous and which ones are meant for the beginner. It is probably best to review two or three different manuals to broaden your view of wetland volunteer monitoring. The descriptions can help you identify the

degree of rigor appropriate for your group.

As you will see, each manual has a different focus, objectives, and often geographic setting. For example, the Long Point Observatory's *Training Kit and Instructions for Surveying Marsh Birds, Amphibians, and Their Habitats* focuses only on amphibian and bird monitoring. An example of another orientation is the booklet published by the Washington State University Cooperative Extension, *A Field Guide to Wetland Characterization and Wetland Plant Guide*. This guide includes only observations, no sampling techniques, and is intended for use in the Pacific Northwest.

Exposure to the variety of approaches in these manuals may help you start thinking about an approach that will suit your goals. Knowing that there is a manual available for monitoring amphibians in the Great Lakes region, you might immediately start thinking about monitoring amphibians if you are organizing a group in Michigan. The *Wetland Walk Manual: A Guidebook for Citizen Participation* might start you thinking about involving school groups in monitoring wetlands and monitoring largely as an enjoyable and educational activity, with some possible scientific benefits.

The wetland monitoring manuals listed in Section C may be very helpful in designing your program, but you probably still need to write your own monitoring protocols to meet your group's needs. The manuals listed can provide the templates for you to derive your own protocols. You might draw a sampling protocol from one manual and another protocol from another manual. For example, you might want to monitor frog calls and hydrologic fluctuations, in which case you could adapt call-survey methods from the Long Point Observatory's *Training Kit and Instructions for Surveying Marsh Birds, Amphibians, and Their Habitats* and crest-staff gauge methods from Adopt-a-Beach's *Monitoring Wetlands: A Manual for Training Volunteers.* (See Section C for these and additional examples.)

It is appropriate to modify the methods and protocols described in these manuals to meet the needs of your

group and the characteristics of the wetland(s) you plan to monitor.

Each manual will differ in focus, objective, and geographic setting.

We recommend that modifications of methods be done in consultation with local naturalists, extension agents, university researchers, or other experts. EPA regional volunteer monitoring and wetland contacts can be helpful. You can call EPA's Wetlands Helpline (1-800-832-7828) for these contacts, or ask for the names of EPA wetlands personnel who may be able to review your draft protocols.

Good luck, and enjoy your wetlands!

photo credit: Matthew Witten

Several manuals list techniques and training that might be helpful in your geographic region.

Section C

Resource Guide to Volunteer Wetland Monitoring

Dwarf iris *(Iris verna)*

Annotated Bibliography of Manuals and Handbooks

Published Documents

Bryan, R., M. Dionne, R. Cook, J. Jones, and A. Goodspeed. 1997. *Maine Citizens Guide to Evaluating, Restoring, and Managing Tidal Marshes*. Maine Audubon Society, Falmouth, Maine. 87 pp. plus about 50 pp. of appendices, in plastic binder.

General scope and tone:
This manual is based on a professional wetland assessment method and is, therefore, quite technical and detailed; however, it helps the layperson by defining terms and explaining the rationale behind every step of the mapping, assessment, and evaluation process. The extensive seven-tiered assessment method uses a numerical scoring system. The manual is aimed at involving citizens in understanding and protecting their coastal wetlands in the context of local planning efforts.

Major strengths and features:
- Very clear, step-by-step explanation of both field and policy procedures
- Detailed instructions on how to make use of National Wetland Inventory maps and how to do mapping in general
- Thorough appendices, including coastal wetland types, a brief summary of the U.S. Fish and Wildlife Service's wetland classification system, sample maps, good-quality photos to help determine scoring, etc.

Orientation:
- Tidal wetlands only
- Emphasis on Maine contacts and regulations, but otherwise applicable elsewhere
- For committed, somewhat science-minded citizens

To obtain:
Maine Audubon Society, 20 Gilsland Farm Road, Falmouth, ME 04105, Tel. (207) 781-2330, or www.maineaudubon.org. $10.

Firehock, K., L. Graff, J.V. Middleton, K.D. Starinchak, and C. Williams. 1998. *Handbook for Wetlands Conservation and Sustainability.* Izaak Walton League of America, Save Our Streams Program, Gaithersburg, MD. 288 pp. including appendices, spiral-bound.

General scope and tone:
The handbook provides broad educational information on the definition, values, and functions of wetlands, as well as many suggestions for educational activities, citizen action, and monitoring. It can serve as an excellent springboard for starting wetland monitoring activities, but in most cases will probably need to be supplemented by professional guidance if the data are to be used for a public purpose. Although this publication is aimed primarily at the beginning wetland explorer and advocate, it includes fairly detailed information about three increasingly rigorous levels of wetland monitoring techniques.

Major strengths and features:
- Very good primer for neophytes on wetland definition, values, and functions
- The appendices include a thorough annotated bibliography of various publications on wetlands covering monitoring, field guides, planning, software, etc.; an extensive list of contacts; and blank data forms.

Orientation:
- Intended for nationwide use
- An education and advocacy document, as well as a monitoring guide

To obtain:
Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD 20878-2983, Tel. (800) 284-4952, or www.iwla.org/SOS/handbook. $38.50 plus $6.50 shipping and handling.

Long Point Observatory, Marsh Monitoring Program. 1997. *Training Kit and Instructions for Surveying Marsh Birds, Amphibians, and Their Habitats*. Long Point Observatory and Environment Canada. 40 pp., 8.5" x 11" supplement to a kit.

General scope and tone:
This booklet is quite focused; it is to be used only in freshwater marshes and basically follows a single protocol for monitoring birds and amphibians. The advantage of this focus is that highly detailed instructions are presented in a manner understandable to the layperson. This booklet is a fine example of biting off only what you can chew. It is written for those who monitor for the "Marsh Monitoring Program," which is specific to the Great Lakes Basin. Unlike some manuals, it is written directly for the volunteer, not the volunteer coordinator. Though the protocols are rigid, the guide emphasizes the fun of participating in volunteer monitoring.

Major strengths and features:
- Highly focused and detailed, yet user-friendly
- Makes clear the level of commitment necessary to participate
- Largely self-guiding, although some assistance may be called for at times
- Thoroughly field-tested

Orientation:
- Based on survey routes and the "point count" method
- Designed for Great Lakes Basin but could be applied elsewhere
- Specific to monitoring birds and amphibians in marshes

To obtain:
Bird Studies Canada, P.O. Box 160, Port Rowan, ON, Canada N0E 1P0,
Tel. (519)586-3531.

Madison, S. 1995. *A World in Our Backyard: A Wetlands Education and Stewardship Program*. New England Interstate Water Pollution Control Commission. 144 pp., including appendix and bibliography, punched for three-ring binder.

General scope and tone:
This guide is designed primarily for middle school teachers to educate their students about wetlands and involve them in protection efforts. The information on wetlands science and values is thorough and concise, and graphics (both drawings and photos) are plentiful. Each chapter includes descriptions of easy-to-follow activities for students to do, including observing and monitoring wetlands.

Major strengths and features:
- User-friendly and aesthetically attractive layout
- Many activity pages and data sheets
- Useful resources and contacts scattered throughout
- Nationwide and even global perspective

Orientation:
- Focuses on the New England region but includes much information about wetlands across the United States and the world
- Useful for most teachers, but familiarity with scientific terms would be helpful

To obtain:
Environmental Media Center, P.O. Box 1016, Chapel Hill, NC 27514, Tel. (800) ENV-EDUC/(800) 368-3382. Video: $29.95, Teachers guide: $19.95, Both: $39.95.

Miller, T., C. Bertolotto, J. Martin, and L. Storm. 1996. *Monitoring Wetlands: A Manual for Training Volunteers*. Adopt-A-Beach, Seattle, WA. 106 pp. plus appendices, punched for three-ring binder. A six-tape video set is also available.

General scope and tone:
This manual, based on *Research Plan and Methods Manual for the Oregon Wetlands Study* (Magee et al., 1993), is specifically designed to help agencies and organizations orient, organize, and train volunteers to monitor wetlands. The style is sufficiently technical to give step-by-step instructions for the field. The manual might be difficult for novices without any science or field experience, but is generally clear, concise, and easy to read. It is geared to gathering quantitative data and offers QA/QC procedures for volunteer efforts. For an A-to-Z manual of how to organize volunteers and conduct an array of field surveys, this is the book to have.

Major strengths and features:
- Based on field experience, it explains and anticipates potential problems
- Excellent guidance on the logistics of coordinating volunteers
- Excellent methods description, data sheets, database for tracking data
- Actual case studies included in nearly every chapter with completed, as well as blank, data forms
- Thorough appendices including references, glossary, further instructions on some hydrology procedures, and an entire case study with narrative, maps, photos, tables

Orientation:
- Somewhat specific to the Pacific Northwest

To obtain:
Washington Wetlands Network of the National Audubon Society, 5031 University Way, NE, Suite 207, Seattle, WA 98105. Tel. (206) 524-4570. $20

Pritchard, K. 1991. *A Field Guide to Wetland Characterization and Wetland Plant Guide*. Washington State University Cooperative Extension, King County, Seattle, WA. 95 pp., small booklet form.

General scope and tone:
This guide, meant for people who are curious about wetlands, helps the "explorer to collect information in a form that is compatible with standard field methodologies." The guide is educational and instructs the reader in collecting wetland data and observing wetland health over time. In its approach to field work, the guide goes step by step (in dichotomous key fashion) through the same observational and reasoning processes that a wetland ecologist goes through in characterizing a wetland.

Major strengths and features:
- Extremely condensed and concise, yet also clear and vivid
- Small, but finely detailed drawings
- Ecology-based, weaving together physical and biological components, often in highly specific ways
- Generally, a field-savvy document with the appropriate cautions regarding methodology and reasoning for the beginner
- Provides some answers to questions regarding characterization of wetlands

Orientation:
- Methods are entirely observational; no sampling techniques or equipment
- Geographically limited to areas of the states of Oregon and Washington west of the Cascades and below 2,000 feet.

To obtain:
EPA's Wetlands Helpline: 1-800-832-7828 or e-mail: wetlands.helpline@epa.gov.

Purinton, T., and D. Mountain. 1997. *Tidal Crossing Handbook: A Volunteer Guide to Assessing Tidal Restrictions.* Parker River Clean Water Association, Byfield, MA. 69 pp., booklet.

General scope and tone:
This guide addresses monitoring of a specific characteristic, i.e., flow restrictions, of one type of wetland and estuary, coastal marshes that are influenced by tidewaters. It is meant for those who are coordinating volunteers and is a practical, step-by-step manual for the assessment process.

Major strengths and features:
- Field-tested and supplemented with a detailed "troubleshooting" section
- Gives historical background
- Offers thorough, yet easily comprehensible, explanation of ecological impacts of tidal restrictions
- Many photos and illustrations

Orientation:
- Specific to tidal wetlands potentially affected by restrictions
- Goal is "taking action" through local and state governments

To obtain:
Parker River Clean Water Association, P.O. Box 823, Byfield, MA 01922,
Tel. (978) 462-2551, or www.parker-river.org/prcwhome.html.

Southam, T., and E. Curran (eds.). 1996. *The Wetlandkeepers Handbook: A Practical Guide to Wetland Care.* B.C. Wildlife Federation, Surrey, BC, and Environment Canada, Delta, BC. 168 pp., including supplements, in three-ring binder.

General scope and tone:
The handbook is written for the layperson and is meant for individuals or groups who want to care for wetlands. It is part educational and advocacy document and part introductory guide to wetland assessment and monitoring. After a brief and general description of assessment techniques, the handbook offers narrative, step-by-step instructions for two types of wetland surveys, surveys of birds and plants. For truly in-depth monitoring, these instructions would need to be supplemented with other manuals or expert advice.

Major strengths and features:
- Frequent emphasis is placed on thorough pre-field work research (e.g., finding out if inventories, maps, or aerial photos already exist)
- Includes very general section on how to promote a citizen stewardship project
- After orientation chapters, five "modules" help focus the reader on action (e.g., public education campaign, monitoring, cleanup)
- Defines basic-level monitoring and more "advanced" monitoring

Orientation:
- Written for citizens of British Columbia, Canada, which is obvious in the large section on laws and rights
- Based on a Canadian wetland classification system, not classical definitions

To obtain:
British Columbia Wildlife Federation, Wetlands Education Program, 1420 Falls Street, Nelson, BC, Cananda V1L 1J4, or Southam Consulting, Tel. (250) 354-1088. $30.

United States Environmental Protection Agency. 1996. *Wetland Walk Manual: A Guide to Citizen Participation*. USEPA Region 10, Seattle, WA. 16 pp. plus a 5-pp. data form, *Wetland Walk Supplement: Worksheets*, both in small booklet form.

General scope and tone:
This manual is a bare-bones guide to recording some systematic observations of wetlands. It is educational in a cursory fashion, mostly helping the reader understand the data forms. It gives a good introduction to wetland observation for volunteers who do not have a lot of time to invest; however, it might not be sufficiently detailed for use in a monitoring program that expects reliable and useful results.

Major strengths and features:
- Useful for the beginner
- Numbered paragraphs in text correspond to numbers on data forms
- Step-by-step instructions for defining latitude/longitude, the most thorough explanation to be found in any of these manuals

Orientation:
- Pacific Northwest focus
- Limited to visual observations of vegetated wetlands

To obtain:
The manual is available on EPA's web site at www.epa.gov/owow/wetlands/wetwalk.pdf.
The worksheets are available at www.epa.gov/owow/wetlands/wetwork.pdf.

Yates, S. 1989. *Adopting a Wetland: A Northwest Guide*. Snohomish County Planning and Community Development (distributed by Adopt-A-Stream Foundation), WA. 22 pp., plus appendices, 8.5" x 11" booklet.

General scope and tone:
This booklet includes a summary of the values of wetland, a history of wetland regulations in the United States, and what the citizen can do to get involved in protecting wetlands. Less a guide than a sort of narrative on wetland policy, it includes a section (under "What You Can Do") that lays out the significance of different types of wetland monitoring. It is a useful document for getting familiar with wetland issues and monitoring approaches.

Major strengths and features:
- Good description of the history of wetland regulations in the United States
- Fairly large, detailed drawings of wetland plant species in the margins
- A step-by-step framework for citizen involvement

Orientation:
- Light on technical detail; not at all a manual or cookbook, but explains the potential significance of various types of monitoring
- Somewhat specific to the Pacific Northwest

To obtain:
The Adopt-A-Stream Foundation, Northwest Stream Center, 600-128th Street, SE, Everett, WA 98208-6353, Tel. (425) 316-8592, or www.streamkeeper.org. $5.

Informal Documents

Georgia Adopt-A-Stream. 2000. *Wetland Monitoring*. Georgia Department of Natural Resources, Environmental Protection Division, Atlanta, GA. 42 pp.

Summary:
This manual guides volunteers in adopting a wetland and monitoring it. It covers getting to know the chosen wetland and its watershed, learning the importance of wetland functions and values, and monitoring wetland hydrology, plants, and soils. The data forms are extensive and detailed.

To obtain:
Georgia Environmental Protection Division, Georgia Adopt-A-Stream, 4220 International Parkway, Suite 101, Atlanta, GA 30354, Tel. (404) 675-1639.

Lipsky, A. 1996. *Narragansett Bay Method: A Manual for Salt Marsh Evaluation.* Save the Bay, Providence, RI. 22 pp.

Summary:
This manual is based on the New Hampshire Audubon Society's "Coastal Method" and is meant to be a first step in the process of gauging the restoration potential of altered and degraded salt marshes in Narragansett Bay. It summarizes the ecology of salt marshes and threats to their health, and it provides a detailed marsh assessment method involving observation of adjacent uplands and a field evaluation of the physical and vegetative characteristics of marshes.

To obtain:
Save the Bay, 434 Smith Street, Providence, RI 02908-3770, Tel. (401) 272-3540, or www.savebay.org/bayissues/narr_bay_method.htm

Additional Resources

Staying Current

The field of volunteer wetland monitoring is expanding rapidly. To keep up to date with current wetland science or to find new ideas, the following resources may help:

EPA's Wetlands Helpline: 1-800-832-7828, wetlands.helpline@epa.gov

EPA's wetlands web site: www.epa.gov/owow/wetlands

EPA's restoration web site: www.epa.gov/owow/wetlands/restore

EPA's volunteer monitoring web site: www.epa.gov/owow/monitoring/vol.html

The spring 1998 issue of *The Volunteer Monitor* newsletter focusing on wetland monitoring is available on the EPA web site at www.epa.gov/owow/volunteer/vm_index.html, along with other back issues of the newsletter.

Supplementary Manuals and Wetland Bibliographies

There are numerous manuals and other materials on volunteer monitoring, wetland science, and wetland policy—too many to list here. Very thorough bibliographies of these resources, some of which are listed below, are available.

A Comprehensive Review of Wetland Assessment Procedures: A Guide for Wetland Practitioners. 1999. Candy C. Bartoldus, Environmental Concern, Inc.

Indicators for Monitoring and Assessing Biological Integrity of Inland, Freshwater Wetlands: A Survey of Technical Literature (1989-1996). 1998. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Wetlands Division (EPA 843-R-98-002).

National Directory of Volunteer Environmental Monitoring Programs. 1998. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds (EPA 841-B-98-009) p. 33, http://yosemite. epa.gov/water/volmon.nsf.

Save Our Streams Handbook for Wetlands Conservation and Sustainability. Izaak Walton League of America, Save Our Streams Program, Gaithersburg, MD.

Volunteer Estuary Monitoring: A Methods Manual. 1993. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds (EPA 842-B-93-004). www.epa.gov/owow/estuaries/monitor.

Volunteer Lake Monitoring: A Methods Manual. 1991. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds (EPA 440-4-91-002). www.epa.gov/owow/monitoring/lakevm.html.

The Volunteer Monitor's Guide to Quality Assurance Project Plans. 1996. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds (EPA 841-B-96-003). www.epa.gov/owow/monitoring/volunteer/qappcovr.htm.

Volunteer Stream Monitoring: A Methods Manual. 1997. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds (EPA 841-B-97-003). www.epa.gov/owow/monitoring/volunteer/stream.

Volunteer Water Monitoring: A Guide for State Managers. 1990. U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds (EPA 440-4-90-010).

There is a variety of wetland books and web pages on the EPA web site at www.epa.gov/owow/monitoring/vol.html

A bibliography of vernal pool monitoring guides can be found at the web site of the Vernal Pool Association, MA. www.vernalpool.org/resc_1.htm

References from the Text

Bartoldus, C.C. 1999. *A Comprehensive Review of Wetland Assessment Procedures: A Guide for Wetland Practitioners.* Environmental Concern, Inc., St. Michaels, MD.

Ely, E., and E. Hamingson. 1998. *National Directory of Volunteer Environmental Monitoring Programs.* U.S. Environmental Protection Agency, Washington, DC.

Hoyer, M. 1999. Personal communication. Florida Lakewatch, FL.

Magee, T.K., S.E. Gwin, R.G. Gibson, C.C. Holland, J.E. Honea, P.W. Shaffer, J.C. Sifneos, and M.E. Kentula. 1993. *Research Plan and Methods Manual for the Oregon Wetlands Study.* Document production by K. Miller. EPA/600/R 93/072. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR.

Norris, R. 1992. Monitoring Data Lead to Stream Protection Order. *The Volunteer Monitor*, vol. 4, no. 1.

Urban Stream Doctors in New York. 1998. *Outdoor America.* Izaak Walton League of America, Gaithersburg, MD.

NOTES

Comment Form

Please photocopy this page and send us your comments.
You are also invited to include information about your volunteer wetland monitoring program.
Mail forms to:

Wetlands Helpline
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., N.W. (4502F)
Washington, DC 20460

wetlands.helpline@epa.gov or 1-800-832-7828

What did you find most useful about this document and/or how can it be improved?

What is your organization doing to monitor, restore, or protect wetlands?

Other comments:

www.epa.gov/owow/wetlands