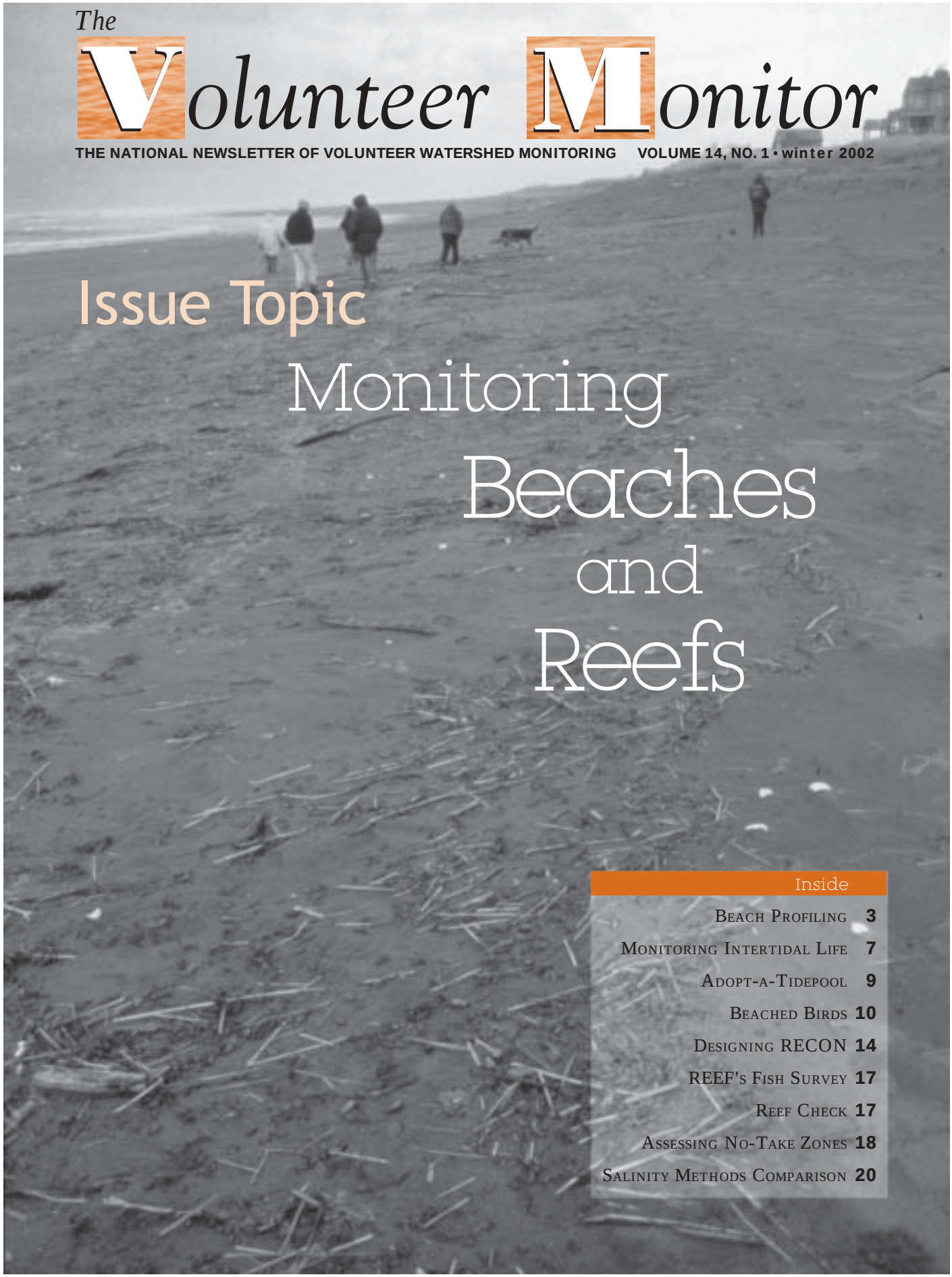
The Volunteer Monitor
THE NATIONAL NEWSLETTER OF VOLUNTEER WATERSHED MONITORING VOLUME 14, NO. 1 • winter 2002



Issue Topic
Monitoring Beaches and Reefs

Inside

The Volunteer Monitor

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

A different volunteer monitoring program serves as coeditor for each issue. This issue was coedited by The Nature Conservancy of the Florida Keys (TNC). TNC provides volunteers to organizations working to protect the natural environment in the Florida Keys.

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For editorial inquiries only, contact Eleanor Ely, Editor, 133 Ninth St., Providence, RI 02906; 401-521-8104; ellieely@earthlink.net
(Note new email address.)

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Editor: Eleanor Ely
Editorial Board: Geoff Dates (River Network, Vermont), Linda Green (University of Rhode Island Watershed Watch), Steven Hubbell (Lower Colorado River Authority, Texas), Tina Laidlaw (U.S. EPA Region 8), Abby Markowitz (Tetra Tech, Inc.), Jeff Schloss (New Hampshire Lakes Lay Monitoring Program), Jerry Schoen (Massachusetts Water Watch Partnership), Christopher Swarth (Jug Bay Wetlands Sanctuary, Maryland)
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next issue: Success Stories

The skeptics don't believe volunteers can collect reliable data. Sure, they say, volunteer monitoring is good for educating the community; but apart from that it doesn't make a real difference.

In this Year of Clean Water—so designated to celebrate the 30th anniversary of the Clean Water Act—let's put the skeptics' objections to rest. In our next issue, "Volunteer Monitoring Success Stories: 30 Years of Making a Difference," we'll highlight volunteer monitors' accomplishments, demonstrating how volunteer monitors have detected bacterial contamination and traced it to its source; caught new invasive species infestations; collected data for setting water quality standards and TMDL (total maximum daily load) levels; used their information in public hearings; contributed data to published scientific research; and many, many more examples.

This special expanded issue will be widely distributed in conjunction with National Water Monitoring Day (see story below). If you have a success story you'd like us to consider, please send a succinct description, including your name and phone number, to ellieely@earthlink.net. We're also interested in hearing about side-by-side comparisons of volunteer and professional monitoring data.

In addition, we'd like to publish stories illustrating the success of this newsletter itself, as measured by your use of the information. Has an article published here inspired you to start a new monitoring activity (or even a whole program)? try a new method or new equipment? form new partnerships? Let us know! (See contact information at left.)

Mark Your Calendars!

National Water Monitoring Day

In honor of the 30th anniversary of the Clean Water Act, 2002 has been declared the Year of Clean Water. Volunteer monitors, agency staff, and members of the public are invited to join the celebration by participating in National Water Monitoring Day, scheduled to commemorate the very day—October 18, 1972—on which the Act was signed into law.

This fall, volunteer and government monitors will take to the waters on or about October 18 to sample a core set of water quality parameters, including temperature, pH, turbidity, and dissolved oxygen. Side-by-side monitoring between volunteers and professionals is strongly encouraged. All protocols, equipment, and monitoring methods are welcome. Even classrooms and citizens who've never tested their water before will be able participate with a simple and inexpensive Year of Clean Water kit. Data and photos will be available almost immediately via the Web.

National Water Monitoring Day will also feature water festivals, educational events, and widespread press coverage. The event is designed to educate the public about water quality issues and the role of monitoring and volunteers; encourage and strengthen partnerships between volunteer monitors and government monitoring agencies; provide a snapshot of water quality 30 years after the passage of the Clean Water Act; and celebrate the accomplishments of the Act while identifying work that still needs to be done. Planning is being spearheaded by America's Clean Water Foundation and a steering committee representing government agencies and volunteer monitoring organizations.

Updates on National Water Monitoring Day, including information on preregistration and ordering the special monitoring kit, will be posted at *www.yearofcleanwater.org*.

Cover photo by Todd Hass (courtesy of COASST).

Shifting Sands: Measuring Beach Erosion

by Eleanor Ely

THE NEWLY TRAINED VOLUNTEERS on the sandy beach at Hull, Massachusetts, were delighted as they finished up their first attempt at beach profiling one morning last October. "What's great about this technique," said one, "is that it's so simple, yet you get so much valuable information." His partner agreed but added, "I wonder if we'll be as enthusiastic come February."

Hull's new beach profiling project is the brainchild of local resident Christian Krahforst, who is by profession a marine scientist with Massachusetts Coastal Zone Management but emphasizes that he is coordinating the profiling project on his own, as a volunteer. He says, "I started to attend the Hull Beach Management Committee meetings, and I became aware that there were many different opinions on whether the beach was eroding or not." After seeing a copy of the Woods Hole Oceanographic Institution (WHOI) Sea Grant bulletin "Beach and Dune Profiles," Krahforst contacted the author, Jim O'Connell, for advice on starting a volunteer program. O'Connell, a coastal geologist with WHOI Sea Grant and Cape Cod Cooperative Extension, has established volunteer profiling projects on three Cape Cod beaches over the last couple of years.

Krahforst recruited a dozen or so Hull residents, and on that cool October morning Krahforst and O'Connell took them down to the beach. Krahforst handed out several large, lightweight wooden frames that he had built. This simple device, assembled from four 5-foot-long strips of wood screwed together to form a flexible parallelogram, was the only piece of equipment volunteers would need to conduct their profiles.

O'Connell then demonstrated how to use the parallelogram to take a series of elevation readings that together would form a picture of the beach's contour from the back dune to the water's edge. As O'Connell explained, the "sighter," who is the person holding the back stick, gazes out to the horizon, then adjusts his or her eye level so that the horizon lines up with the top of whichever stick is lower. For most of the profile the beach is sloping downward so the front stick is the lower of the two. In this case the sighter lines up the top of the front stick with the horizon line, then reads the mark on the back stick at the point where the top of the front stick appears to intersect it. Both the front and back stick are marked off in intervals, which may be inches, centimeters, or tenths of a foot. The trainees caught on quickly and were soon working their way toward the water, using the width of the parallelogram to measure off the horizontal distance between each elevation reading.

> The equipment is cheap and easy to make, training takes less than an hour, and measurement is quick and straightforward.

This profiling method, one of many variations on the "Emery rod method" first published by K.O. Emery in 1961 (see sidebar on page 5), is ideal for volunteer use: the equipment is cheap and easy to make, training takes less than an hour, and measurement in the field is quick and straightforward. Yet simple as it is, the method is also powerful: performed regularly over a period of years, profiles give detailed, quantitative information on how the beach and dunes change from season to season and year to year.

Three is the ideal number of people for profiling: one person for each stick and one to record the readings. Two can do it; or, in a pinch, even one (a tape recorder helps). An experienced team can complete a profile in 10 to 20 minutes, depending on the width of the beach.

The Hull volunteers plan to monitor five locations along the beach at least twice per year to capture the seasonal extremes. At the end of August they

continued on next page

ELEANOR ELY

Volunteers at Hull, Massachusetts, learn to use parallelogram-shaped beach profiling device.

PROFILING, continued

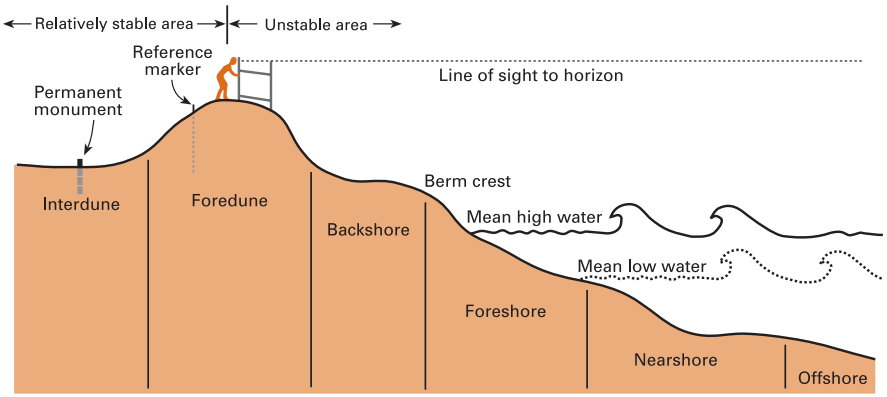
will record the annual maximum, and at the end of February they will profile a beach that is lean and shrunken from winter storms. In addition, they will take before-and-after profiles for major storms. An unfortunate fact of life for beach profilers is that the most significant and interesting changes occur during the worst weather.

For maximum usefulness, profiling should continue for years or decades. Beginning each profile at exactly the same spot is essential for making valid comparisons over time, so a reference marker must be established to permanently identify the start point. O'Connell recommends a 10-foot length of half-inch-diameter copper pipe pounded into the dune. For extra insurance, volunteers should establish a permanent monument further inland to serve as a backup in case the reference marker is lost. O'Connell also suggests that volunteer groups enlist expert help to survey the elevation of the permanent monument. Knowing true elevation allows them to relate their profile data to historical data such as the 100-year flood level.

The problem: erosion

Beach erosion is the big issue propelling the Massachusetts groups, as well as other volunteers in Maine, to go out and collect data in all kinds of weather. These volunteers want to know if their beaches are getting narrower over time, or if dunes are shrinking. They want to understand how different beaches respond to winter storms and find out where property is at risk.

The term "erosion" covers any process that removes material, whether temporarily or permanently, from a given location. The long-term wearing away of coastal bluffs is a type of permanent erosion. Seasonal changes, by contrast, are short-term and cyclical. Most beaches tend to erode in winter as powerful storm waves pull sand from the beach and deposit it on nearshore bars. The following summer, low-energy waves transport the sand back onto the beach. Relative sea level rise, which reflects the combined effects of land subsidence (sinking) and the true global rise in sea level, is another long-term process that causes loss of shoreline lands as the beach retreats landward.



Adapted from O'Connell, 2001, "Beach and Dune Profiles."

Why do these changes matter? From a strictly ecological point of view, they don't. Erosion is a natural process. It is in the nature of coastal bluffs to gradually wear away under the force of rain and wind; indeed it is this very process that creates and feeds beaches. It is in the nature of sand to shift, and it is in the nature of shorelines to constantly change shape.

> Profile data collected by volunteers brings objectivity and understanding to management discussions.

Problems arise when the natural process of erosion conflicts with human uses and development. Erosion becomes a problem when people see the beach in front of their property, or a popular public beach, getting smaller year by year. It becomes a problem when houses built on a bluff collapse, or when a house that was originally beyond the reach of winter storm waves now finds itself in harm's way.

How bad is it? According to the Federal Emergency Management Agency's (FEMA) *Evaluation of Erosion Hazards*, published in 2000 and available at *www.fema.gov/nwz00/erosion.htm*, there are currently some 350,000 structures in the United States located within 500 feet of an ocean or Great Lakes shoreline. On average, over the next several decades, we can expect to lose 1,500 of these to erosion *each year*.

What not to do

Losses due to erosion affect not just individual homeowners or beachgoers, but whole towns that see their tax base shrinking and tourism declining. Historically, individuals and communities have reacted by installing structures designed to control erosion, such as seawalls, jetties, and groins. As usual, though, nature has had the last word as many such "armoring" structures have themselves become major contributors to erosion. Often the beach in front of a seawall disappears because the wall cuts off the beach from inland bluffs that were its source of sand. Moreover, on an eroding beach the high tide line continues to move landward while the seawall is stationary, resulting in a progressively smaller beach. Jetties and groins tend to cause sand to build up on one side and be lost on the other. Nowadays, most states strictly regulate and limit the installation of armoring structures; but few require removal of existing structures, so the legacy of past engineering remains to be dealt with.

Better management options

There are better ways to deal with erosion. Of course the most effective method is prevention—i.e., not building in high-risk zones—and many states are now implementing setback regulations. But even for those thousands of buildings already at risk, alternatives exist to "hard" engineering approaches. These include:

- *Beach replenishment (nourishment).* Sand dredged from offshore or obtained from an inland source is placed on the beach. This is not a permanent fix because eventually

the sand washes away, but a few beach nourishment projects have lasted several decades.

- *Dune restoration*. Dunes can also be replenished with sand. A longer-lasting solution is to plant vegetation to stabilize the dune. In either case, sand fences help retain sand.
- *Relocation of buildings*. Sometimes moving a building back from the shore is the best (or only) option.

Erosion management can become very contentious. For example, some shorefront property owners might want to build up and revegetate a local dune to protect property, while others might prefer leaving the dune as it is to preserve a good ocean view. As noted in the Southern Maine Beach Stakeholders Group's final report ("Improving Maine's Beaches"; *www.smrpc.maine.org/BeachPlan/finalrep.html*), "One person's view of improvement is another person's step backwards."

Profile data collected by volunteer monitors brings objectivity and understanding to management discussions by showing which beaches are eroding and how fast or by documenting the effects of structures like seawalls and groins. Profiling also indicates what size dune can withstand what level storm and which beaches are good candidates for replenishment.

Converging efforts in Massachusetts

The profiling in Hull is the latest of several such projects undertaken by Massachusetts volunteers. As mentioned above, O'Connell has trained volunteer groups in three Cape Cod towns, and Falmouth citizens have also recently started profiling local beaches. Meanwhile, at Waquoit Bay National Estuarine Research Reserve (WBNERR), volunteers have been profiling the reserve's 3-mile shoreline since fall 2000.

O'Connell is working to involve more Massachusetts beaches in profiling and to, as he puts it, "thread all the programs together" to make data comparison easier. He is encouraging the various groups to coordinate annual profiling dates to within a few days of each other, and he hopes to eventually create a Website and hold a statewide annual conference.

continued on next page

Profiling Methods: Variations on a Theme

Perhaps because its basic principle—using the horizon as a level line—is so simple, the Emery rod method of beach profiling has been subject to many modifications. Even among volunteer programs several variations are in use.

The parallelogram method described in the accompanying article has the advantage of keeping the upright rods aligned with each other, which makes it possible (though awkward) for profiling to be done by an individual working alone. However, the rigid frame becomes impractical on very rough terrain or when an object such as fence crosses the profile path.

Volunteers in Maine connect their profiling rods with a chain or rope marked off in intervals. This flexible design makes it easier to deal with obstacles and also allows varying the horizontal distance between readings, but it requires more care in keeping the rods parallel.

The variation employed at Waquoit Bay National Estuarine Research Reserve (WBNERR) uses just a single, very tall pole. One partner (the observer) stays stationary on the dune while the other moves the pole down the beach. The pole-carrier also carries a smaller stick. At each profile point, the observer directs the beach partner, by voice or hand signals, to slide the small stick up or down along the pole until it lines up with the observer's sight line to the horizon. An advantage to this method is that an error in one reading does not affect subsequent readings (in contrast to the two methods described above, in which errors are compounded). One drawback is the difficulty of holding the tall pole steady in a strong wind.

KRISTEN WHITING-GRANT

Maine volunteer beach profilers use two rods connected by a rope.

No horizon?

Sometimes you can't see a clear horizon line. For example, the first few readings are typically on the backside of a dune. In this case the person in back can sight through a handheld sighting level (about $20), which looks like a little telescope with a bubble level inside. It is even possible to conduct the entire profile with the sighting level on days when fog or clouds obscure the horizon. However, according to Jim O'Connell, this takes longer and is less accurate than using the horizon.

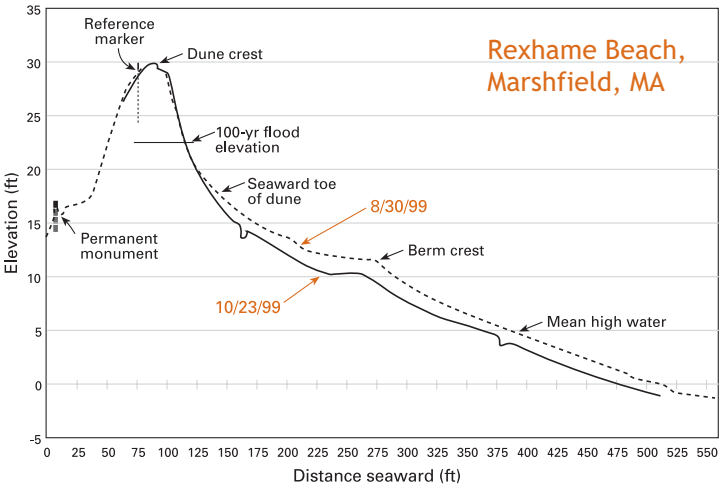
Quick and dirty

WBNERR, like all the NERRs, has a strong focus on advancing scientific understanding. Accordingly Research Director Chris Weidman designed WBNERR's profiling study with a very high density of measurements. Bimonthly from October to April, volunteers collect data every 200 feet along the beach, for a total of 73 stations. The time and effort required to profile this number of sites would be prohibitive, so complete profiles are done at only about one site in four. However, a "quick and dirty" method requiring only a tape measure is used at all 73 sites. As volunteers walk from the dune toward the water line, they measure and record the horizontal distance between four easily recognizable features: the foredune crest, the seaward vegetation line, the most seaward berm crest, and the toe of the foreshore. The first of these two features are indicative of long-term erosional changes, while the second two move daily in response to short-term tidal and wave conditions.

Centralized coordination in Maine

The kind of statewide coordination that O'Connell envisions for Massachusetts is already a reality in Maine. In contrast to Massachusetts, where various small beach profiling projects sprang up independently, Maine started off with a relative bang in the summer of 1999 with the creation of a centrally organized program involving 80 volunteers on 10 beaches. Today the Southern Maine Beach Profile Monitoring Program has grown to 120 volunteers on 15 beaches, coordinated by Maine Sea Grant Extension Associate Kristen Whiting-Grant. Profiling data are posted online (*www.geology.um.maine.edu/beach/*) and presented at annual meetings.

Maine's program was started by three geologists from the University of Maine and Maine Geological Survey (MGS) who applied for and received two years of funding from Maine Sea Grant. (Although the initial grant has now ended, the profiling project is continuing with a commitment of staff support from all three partner institutions.) The early infusion of financial support no doubt helps account for both the program's quick startup and its ambitious scope—all the beaches are profiled every month, yearround, within a window of a few days to control for weather conditions and storms. "The simultaneous collection of data over a large geographic area is the most important scientific advantage of this program," says MGS coastal geologist Stephen Dickson, one of the program's three original founders. "Now we can look at how the whole beach system up and down the coast responds to storms and tides."



Profiles at summer maximum (8/30/99) and after a storm (10/23/99). From O'Connell, 2001, "Beach and Dune Profiles."

Besides its scientific research value, the Maine volunteers' data will have a number of practical management applications. Dickson says, "I get calls all the time regarding beach erosion." Some of these calls involve the proper siting of new development. Maine law requires all new homes to be situated outside the area subject to erosion hazard within 100 years—"a stringent restriction compared to most other states," according to Dickson. Profiling data helps define the boundaries of that area for a given beach.

Communities faced with decisions about beach replenishment have a particularly acute need for reliable erosion data, since nourishment costs several million dollars per mile. Dickson says, "For agencies or community organizations who will be footing the bill, the big questions are, how much sand is needed and how long will it last? If erosion is high and the replenishment may only last a few years, the town may decide they can't afford it."

Every beach is unique

There's no shortcut for determining beach erosion without going out and doing profiles. "Every beach is unique," says Dickson. "We can't answer these questions without having profile data for a particular beach." That being so, volunteer beach profilers are going to be in demand for a long time to come.

Readers who may be interested in starting a beach profiling program in their community are invited to consult the individuals listed below:

Jim O'Connell, Coastal Processes Specialist, WHOI Sea Grant, 195 Oyster Pond Rd., MS #2, Woods Hole, MA 02543-1525; *joconnell@whoi.edu;* 508-289-2993

Kristen Whiting-Grant, Coordinator, Southern Maine Beach Profiling Project, Maine Sea Grant Program, Wells National Estuarine Research Reserve, 342 Laudholm Farm Rd., Wells, ME 04090; *kristen.whiting-grant@maine.edu;* 207-646-1555 x115; *www.geology.um.maine.edu/beach/*

JIM O'CONNELL

Quivet Neck Homeowners Association member Derek Boyle profiles a beach at East Dennis on Cape Cod.

RESOURCE

O'Connell, Jim. 2001. "Beach and Dune Profiles: An Educational Tool for Observing and Comparing Dynamic Coastal Environments." This 6-page WHOI Sea Grant Marine Extension Bulletin gives detailed instructions for the parallelogram method of beach profiling. Free. Available from Jim O'Connell (address above).

Thanks to Jim O'Connell for assistance in the preparation of this article.

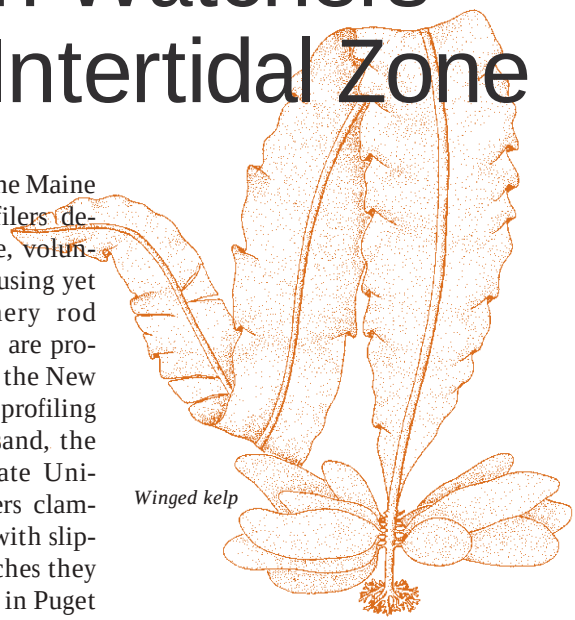
Life on the Beach

Beach Watchers Survey Intertidal Zone

by Eleanor Ely

ACROSS THE CONTINENT FROM the Maine and Massachusetts beach profilers described in the preceding article, volunteers in Washington State are using yet another version of the Emery rod method—but the beaches they are profiling look very different. While the New England volunteers move their profiling rods across broad expanses of sand, the Island County/Washington State University (WSU) Beach Watchers clamber over rocky terrain covered with slippery seaweeds. Most of the beaches they monitor are on Whidbey Island in Puget Sound, near Seattle.

"Our beaches are teeming with life," says Beach Watcher Jan Holmes, who's been involved with the program for 11 years. Nonhuman life, that is. No throngs of tourists crowd these beaches, which are notably short on surf, sun, and (in most cases) sand. But those attributes so prized by humans are just about the opposite of what most intertidal life forms consider desirable. What small worm or snail wants to be pounded by waves and washed every which way on moving sand, only to be left high and dry when the tide goes out? Give them a nice pebbly beach lapped by low-energy waves. Such a place offers lots of amenities: attachment spots for seaweeds, barnacles, and anemones; hiding places for crabs and amphipods; sheltered patches of sand for clams and burrowing worms. Throw in some fog to keep everything moist between tides, and you've got—from the invertebrate perspective—prime shorefront real estate.



Winged kelp

MARY JO ADAMS

WSU Beach Watchers profile elevation on a rocky Whidbey Island beach.

Different environments lead to different priorities for volunteer monitors. On Whidbey Island, beach profiling is not an end in itself, as it is for New England groups tracking erosion, but just the first (and easiest) step in an ambitious program to inventory and monitor intertidal life. Within a 10-foot swath along the profile line, Beach Watchers note the presence and location of several substrate types; some two dozen categories of invertebrates (snails, mussels, sea stars, limpets, worms, and many others); and red, green, and brown seaweeds. Surveys are done at low tide when the maximum area is exposed. The results are summarized in a graph on which the basic profile line is festooned with multicolored lines and shapes showing the tidal elevation range at which each substrate or organism type was observed (see illustration on page 8; unfortunately, the colors can't be reproduced here).

Actually this graph, dense with information as it is, displays only part of the Beach Watchers' work. After the profile line and presence/absence survey are completed, volunteers turn to the quantitative portion of their monitoring. They lay out transects to determine nine locations for detailed data collection—three each at the plus-1-foot, zero-foot, and minus-1-foot tide levels. At each site, volunteers place a quarter-meter quadrat frame within which they identify and quantify (by count or percent cover) every plant and animal. Currently Beach Watchers conduct surveys on 28 beaches.

"Every time I go through the field sheets and enter the data I'm just flabbergasted that we talked 85 or 90 people into doing all this," says Holmes. "And for the most part it's the same people who have kept it up year after year."

MARY JO ADAMS

All seaweeds and invertebrates inside the quadrat are identified.

Honing the methods

Beach Watchers started in 1990, the same year Holmes joined, but it took five years to arrive at the final beach

continued on next page

Drawings in this article from Eugene Kozloff, *Seashore Life of the Northern Pacific Coast: An Illustrated Guide to Northern California, Oregon, Washington, and British Columbia* (University of Washington Press, 1993). Reprinted by permission of the University of Washington Press.

monitoring methods. Don Meehan, chair of Island County/WSU Cooperative Extension and founder of Beach Watchers, says, "I knew I wanted Beach Watchers to do a biological assessment, but I had a hard time finding a model." Meehan was interested in the biology because, he explains, "I think of the intertidal area as an indicator zone for the health of both the upland area and the marine waters."

Meehan assigned a student assistant to look for other monitoring programs doing similar work, but she could find none anywhere in the United States. Finally the search led to Jack Serwold, a marine biology professor at a local community college, who had developed protocols for beach profiling and biological assessment and was willing to train Beach Watcher volunteers. Serwold set the program moving in the right direction, but some of the methods he was using, such as scraping organisms off rocks and weighing them to calculate biomass, proved to be too involved for the volunteers.

Volunteers take the lead

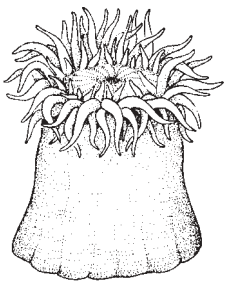
At this juncture, the volunteers themselves took on the responsibility for revising the methods. Fortunately the program had several very knowledgeable volunteers—including Holmes, who had been inspired by her involvement with Beach Watchers to pursue a master's degree in marine biology. "Beach Watchers attracts people who like science and want to learn," says Meehan.

The volunteers formed a committee and proceeded, as Holmes describes it, to spend "hundreds of hours grinding away at a workable solution." At one point they considered offering participants a whole range of options. "Some people are intimidated by the word 'data,'" says Holmes, "so we thought, let's have a continuum—some people can just take pictures or keep a journal." But ultimately the group decided they needed consistent methods that everyone would follow. In 1995, following a great deal of research and trial-and-error, they settled on the current protocols.

Most people would probably say that the Beach Watchers' methods are still quite demanding. Volunteer monitors go through two full days of initial training plus additional workshops and are called upon to identify dozens of organisms. Yet, Holmes points out, the compromises that were made to accommodate volunteer monitors do impose certain limitations compared to a research-level study. Most beaches are monitored just once a year, making seasonal comparisons impossible, and the relatively small number of quadrats used means that only the more prevalent organisms will be observed. "But you can't do it all," says Holmes. "I think we are at just about the right level."

By now all the volunteers are very adept at profiling their beaches and collecting the presence/absence data, but the quadrat study, with its requirement for genus-level identification, still poses a challenge for some. Here again, the program's "expert" volunteers come to the rescue, accompanying less experienced teams on their surveys. "You can't imagine all the time they're investing," Meehan says of this core group of volunteers. "Their dedication and time and knowledge are really what makes this program successful."

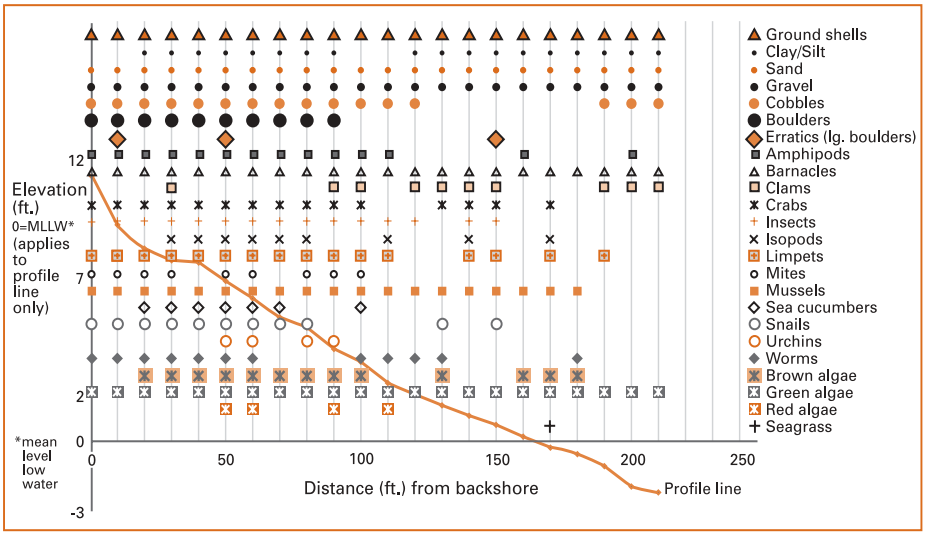
Beach Watchers also has a strong outreach component that includes public workshops, visits to school classrooms, and an annual water festival. Meehan says, "Our volunteers have to learn all these organisms; they have to understand what goes on in the intertidal zone. That gives them the ability to communicate to the public that this is a very special and very sensitive place, full of special organisms."



Sea anemone

Beach Watchers' procedures are described in detail in the program's training manual, *Beach Monitoring Procedures*; available from Island County/WSU Beach Watchers, P.O. Box 5000, Coupeville, WA; 360-679-7391 (PDF format free via email; hard copy $20). For additional information, contact Don Meehan at *meehan@wsu.edu* or Beach Watchers Program Coordinator Sarah Schmidt at *sarahs@wsu.edu*.

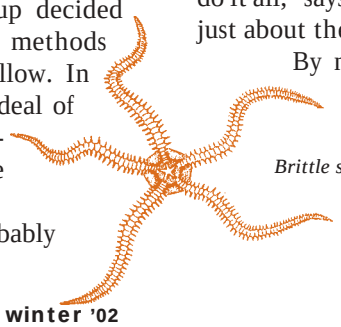
Profile and Surface Composition



Adapted from WSU Beach Watchers graph.

MARY JO ADAMS

Shaggy mouse nudibranch (sea slug).



Brittle star

Adopt-a-Tidepool

Lots of people enjoy "tidepooling" on a lazy summer afternoon. Adopt-a-Tidepool volunteers in Massachusetts raise this casual activity to a science, committing to regular monitoring of seaweeds and invertebrates in selected tidepools. The sampling schedule—once per season in the winter and spring, then monthly from June through October—guarantees at least a few chilly sessions.

Some tidepool adopters have scientific backgrounds, but this is not a requirement. "It's a great project for families," says April Ridlon, who coordinates Adopt-a-Tidepool for Massachusetts Audubon Society's North Shore office. Adults enjoy the challenges of identification, and even young children can help out by counting sea stars and crabs.

The program had its origins a few years ago when Ridlon and Robert Buchsbaum, a conservation scientist at Massachusetts Audubon, began monitoring a number of pools from Cape Ann to Nahant. "New England's rocky intertidal zone was the site of some intensive, seminal studies in ecology 30 or so years ago," says Buchsbaum, "but recently no one has paid much attention to this habitat, at least not in a consistent manner." After the first year it became apparent that more help was needed to provide a comprehensive assessment. Massachusetts Audubon trained 15 volunteers in 2000 and 20 more in 2001. Salem Sound 2000, a nearby nonprofit group, joined the effort in 2001 and trained a group of their own volunteers. Currently some 40 volunteers are monitoring pools that range in location from high to low in the intertidal zone and in size from "about desktop size to as big as a living room," according to Ridlon.

CINDY DUNN

Salem Sound 2000 volunteers monitor their adopted tidepool.

"We struggled with deciding which species to list on our data sheet," says Ridlon. "We wanted to include enough species to get reliable, ecologically interesting information that could answer our basic questions, but not so many that volunteers might become overwhelmed. Some of the organisms, especially the seaweeds, are notoriously difficult to identify in the field, even for experts. Our level of data lets us see large-scale changes, such as seasonal fluctuations in abundance."

The Adopt-a-Tidepool data sheet includes 17 types of commonly found seaweeds and 22 animals. Seaweeds are quantified by percent cover and animals by either number (e.g., snails, sea stars) or percent cover (e.g., sessile organisms like mussels and barnacles). To assist the volunteers, Ridlon recently created a key to local seaweeds by scanning pressed seaweeds into a computer and printing out the images on a color printer.

Buchsbaum and Ridlon plan to use the tidepool data to establish a baseline for comparison with past and future studies, track seasonal patterns and year-to-year variations, and study how pool size, shape, and location affect organism diversity.

ROBERT BUCHSBAUM

Green urchin underside.

They also plan to look for effects of human activities. Some of the pools receive many visitors and/or are located near highly developed areas while others are in more isolated locations. Finally, they are interested in documenting and tracking the extent of colonization by nonnative species such as the Asian shore crab, Pacific colonial tunicate, golden star tunicate, and several others. "Long-term observers have told us that the biggest change they've seen along our coastline over the last 50 years is an increase in nonnatives," says Buchsbaum.

Noting that ecological surveys are rarely "neat and tidy," Ridlon cheerfully admits that things get even messier "when ecology meets volunteers." But this doesn't bother her. "Our volunteers are learning a great deal and helping us to gather scientifically valid data, and most important, it's fun," she says.

For more information contact April Ridlon, Massachusetts Audubon: North Shore, 346 Grapevine Rd., Wenham, MA 01984; 978-927-1122 x 2706; aridlon@massaudubon.org.

ROBERT BUCHSBAUM

Monitor records data on high tidepool in Cape Ann, Massachusetts.

ROBERT BUCHSBAUM

Forbes sea star.

Beached Bird Surveys
Dead Birds Do Tell Tales

by Eleanor Ely

MONTEREY BAY NMS

Common Murre, Rhinoceros Auklet.

THE IDEA OF MONITORING dead birds might take a little getting used to. "Wet, decomposing carcasses can smell bad and may fall apart when handled," warns *Beached Birds*, the field guide developed for the COASST (Coastal Observation and Seabird Survey Team) program. And the protocols for COASST volunteers offer the following tip for determining whether a specimen was the victim of a bird of prey: "Raptors will carefully pull the breast and neck skin back over the head . . . leaving the carcass with a macabre turtleneck appearance."

"At first, people may think it's gross—but even in death the body parts are beautiful, and you can get a good close look," says Andrew De Vogelaere, a founder of the Monterey Bay National Marine Sanctuary's (NMS) Beach COMBERS (Coastal Ocean Mammal/Bird Education and Research Surveys). Besides, he says, "Our volunteers take pride in working in an esoteric field."

BEACHED BIRD VOLUNTEERS HAVE DOCUMENTED PROBLEMS RANGING FROM OIL SPILLS TO HARMFUL ALGAL BLOOMS TO SEABIRD BYCATCH IN FISHING NETS.

Participants in COASST, Beach COMBERS, and similar surveys have a lot to be proud of. Since most dead birds found on a beach are marine species that live and die at sea, the corpses that wash ashore bear silent witness to offshore conditions, at times providing the first sign that something is amiss. Beached bird volunteers have played a role in documenting, and sometimes resolving, problems ranging from oil spills to harmful algal blooms to seabird bycatch in fishing nets.

TODD HASS

COASST trainees in Oregon record observations of a newly beached murre.

A brief history

Beached bird surveys involving citizen volunteers have been conducted in Europe since the mid-20th century. The first North American effort was started by the Point Reyes Bird Observatory (PRBO), on the central California coast, in 1971. That program ended in 1985, but the 1990s saw the establishment of three new programs. The Gulf of the Farallones National Marine Sanctuary (GFNMS), located in the San Francisco Bay Area, started its Beach Watch program in 1993, and the neighboring Monterey Bay NMS began Beach COMBERS in 1997. In 1999, COASST was founded in the Seattle area. No similar programs exist on the U.S. East Coast, but in late fall 2001 Bird Studies Canada and the Canadian Wildlife Service launched the Cape Breton Beached Bird Survey in New Brunswick (see *www.bsc-eoc.org*).

PRBO: Saving birds from fishing nets

No one could have guessed, when PRBO began its Beached Bird Project in 1971 in response to a large oil spill in San Francisco Bay, that a decade later the program would be instrumental in saving marine birds and mammals from being killed in gill nets. The immediate issue was how to assess mortality from the spill. "As dead birds washed up, lots of questions arose about how many you would normally find, and no one knew the answer," says PRBO biologist Lynn Stenzel, who managed the Beached Bird Project for many years. To fill this gap in knowledge, volunteers began conducting monthly censuses, counting and identifying beached birds and mammals and recording observations such as age, sex, and the type and extent of any oiling.

All the volunteers were experienced birders, yet it quickly became apparent that their skills in identifying live birds

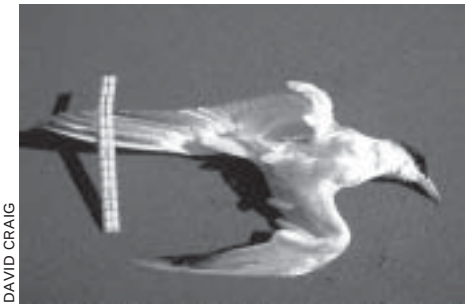
were not always adequate for this new task. Accordingly, a group of bird biologists from PRBO, along with a few other local experts, teamed up to produce *Beached Marine Birds and Mammals of the North American West Coast*, the country's first field guide designed specifically for identifying beachcast birds and animals. [*Note:* This guide was updated in 1993 with assistance from GFNMS; see page 22 for ordering information.]

Dead birds, no oil

As the Beached Bird Project grew, the volunteers amassed a solid database that covered 82 shoreline segments, providing PRBO researchers with valuable insights into the problem of chronic oiling and the effects of natural phenomena like droughts or El Niño events. Then in July of 1981, volunteers in the Monterey Bay area suddenly began finding beached birds in the hundreds on beaches where normally they saw few or none. Most were Common Murres or Sooty Shearwaters, marine species that dive deep for fish. None showed any sign of oiling.

TODD HASS

DAVID CRAIG



TODD HASS

Clockwise from left: Western Grebe, Caspian Tern, Short-tailed Shearwater. From Hass and Parrish, 2000, *Beached Birds: A COASST Field Guide.*

The explanation for these alarming observations was soon discovered. The drastic increase in seabird mortality coincided closely with a large influx of gillnetting boats into Monterey Bay waters. Gill nets, which hang vertically in the water like giant invisible curtains up to a mile and a half long, are extremely efficient at catching fish. Unfortunately, they are also very effective at catching diving seabirds, as well as marine mammals such as seals and sea lions.

"We got a jump on the problem because we had knowledgeable volunteers out there observing," says Burr Heneman, former Executive Director of PRBO.

THE DRASTIC INCREASE IN SEABIRD MORTALITY COINCIDED CLOSELY WITH A LARGE INFLUX OF GILLNETTING BOATS.

"And the baseline data gave us the ability to prove how serious and extraordinary the level of mortality really was." In the Fall 1981 issue of the PRBO newsletter, Heneman wrote, "We are pleased to report that PRBO's ten-year-old Beached Bird Project is accomplishing one of the things it was designed to do: provide a perspective for evaluating catastrophic seabird die-offs."

The carcasses found in July 1981 marked the beginning of six years of conflict and controversy, during which time an estimated 100,000 seabirds (mainly Common Murres) and thousands of marine mammals were killed in gill nets along the northern and central California coast. PRBO took a leading role in the search for a solution, and received continuing support from the work of volunteer monitors.

In the summer of 1983, PRBO volunteer Eleanor Borden began watching gillnetters through binoculars from her strategically positioned Muir Beach home, counting the birds caught in nets. Her observations supplemented data from California Department of Fish and Game (CDFG) observers operating from boats. Because the fishermen did not know that Borden was watching, she was also able to observe attempts to conceal the extent of the bycatch. One day the fishermen, who by this time were well aware of the public outcry over dead birds on beaches, put 70 bird carcasses into a weighted plastic bag and dumped it overboard; another time, they moved their boat close to a rocky, inaccessible area of coastline before tossing the birds. Meanwhile, data from another PRBO volunteer monitoring program—a long-term census of breeding birds—revealed that the high mortality in fishing nets was taking a significant toll on Common Murre breeding populations. Finally, in 1987, the bycatch issue was resolved with the passage of legislation imposing strict regulations and closures on the gill net fishery.

Beach Watch:
Assessing damage from oil spills

There are many ways to quantify the accomplishments of the GFNMS Beach Watch program. It could be pointed out that the program's current corps of 110 volunteers conducts regular monthly or biweekly surveys on 241 km (149 miles) of coastline, or that since the program's inception in 1993 Beach Watchers have counted and photodocumented nearly 6,000 bird and marine mammal carcasses and identified 85 different species of beached birds, or that participants undergo a rigorous 82-hour course of training and contribute over 10,000 hours each year.[1]

Yet one of Beach Watch's most far-reaching impacts may be best measured in terms of dollars—specifically, the increase in dollars paid in mitigation settlements for oil spills. GFNMS Manager Ed Ueber explains that traditionally oil spill damages have been measured primarily in terms of the number of gallons spilled. Without baseline data, damages to wildlife have been hard to prove. But now, Ueber says, Beach Watch data have

continued on next page

[1] For a detailed description of Beach Watch training and procedures, see "Surveying the Shoreline" in *The Volunteer Monitor*, Fall 1996.

BEACH WATCH, continued

brought about a change in perception, taking damage assessment "out of the realm of the physical and into the realm of living resources." As evidence, Ueber points to two recent spills, the *Cape Mohican* (1996) and *Command* (1998), in which settlements included upwards of $4 million expressly designated as reparations for damage to living resources.

Of course oil spills are not Beach Watch's only focus. The program was designed to assist the sanctuary in detecting and understanding any natural or human-caused perturbation that affects the mortality of birds and marine mammals, and Beach Watchers have documented several die-offs due to disease. Yet so far oiling has been the most important issue the volunteers have dealt with. When a spill occurs, the Coast Guard calls on Beach Watch for help. Some Beach Watch volunteers have gone out daily for as many 30 days to assist the Coast Guard and other agencies in documenting dead and oiled wildlife and collecting specimens. They are well prepared for this work by the basic Beach Watch training, which includes a session taught by staff from CDFG's Office of Spill Prevention and Response (OSPR). Volunteers are taught how to safely collect tarballs or oiled feathers, place specimens in a chemically cleaned jar (provided by OSPR), seal the jar with evidence tape, and fill out a chain of custody form.

SETTLEMENTS IN TWO RECENT SPILLS INCLUDED UPWARDS OF $4 MILLION EXPRESSLY DESIGNATED AS REPARATIONS FOR DAMAGE TO LIVING RESOURCES.

Tarballs tell tales too

Not all oiling events are as dramatic as spills. Chronic oiling, caused by boats dumping bilge water or oil tankers flushing their tanks, also damages wildlife. Tarballs (weathered balls or patties of oil) on the beach provide important clues to the oil's origin. Of the hundreds of tarballs that Beach Watch volunteers have sent to the OSPR lab for "fingerprinting," the majority have tested out as Alaska crude. "That tells us there is a large amount of unknown spills from the tanker trade," says OSPR Senior Environmental Scientist John Tarpley. The evidence from tarball analysis led to a voluntary agreement with the Western States Petroleum Association that tankers would stay at least 50 miles offshore.

Beach COMBERS: Sounding the alarm

By their nature beached bird surveys are low-tech, and the Beach COMBERS program has one of the less demanding protocols: volunteers count and identify dead birds and marine mammals but don't photograph, measure, or tag them. Yet in the program's first two years of existence the volunteers "red flagged" two important problems, demonstrating once again the value of having trained volunteer monitors in the field serving as eyes and ears.

Beach COMBERS had been in operation only a few months when, in August of 1997, the volunteers suddenly found hundreds of dead Common Murres on Monterey Bay beaches. It was like 1981 all over again, but at first no one suspected gillnetting, which had virtually disappeared from the area after strict regulations were put in place. However, it turned out that this method of fishing had recently increased in the bay and was indeed causing the observed mortality. This discovery led to the reinstatement of a National Marine Fisheries Service observer program that had been discontinued a few years earlier, and the proposal of new regulations to push the fishery out into deeper waters.

The following spring, Beach COMBERS on their rounds encountered a large increase in numbers of dead sea lions. During May and June 1998 they documented over 100 carcasses, many on remote beaches where they would not otherwise have been noticed. At the same time, local researchers were also collecting and studying sea lion carcasses, as well as live sea lions that were displaying unusual neurological symptoms. The final sea lion death toll topped 400, including those counted by Beach COMBERS.

After an intensive collaborative effort, scientists determined that the sea lions were suffering from domoic acid poisoning caused by a bloom of the diatom *Pseudo-nitzschia australis*. The sea lions were exposed to the toxin through eating anchovies that in turn had fed on the algae. This incident marked the first time that the death of a marine mammal was conclusively linked to an algae bloom.

MONTEREY BAY NMS

Beach COMBER volunteers record data on a harbor seal.

COASST: No prior experience required

I'm one of those people that can recognize a robin and a seagull and about three other birds. But when I looked through a copy of *Beached Birds*, COASST's field guide, I thought, I could do this! I could learn to identify beached birds.

That is exactly the effect that authors Todd Hass and Julia Parrish intended. Whereas the PRBO guide was created with experienced birders in mind, Parrish says that she and Hass "wanted to be able to take someone who starts off knowing just two facts, 'it's a bird' and 'it's dead,' and get them to species identification at least 80 percent of the time." *Beached Birds* has a logical, intuitive layout, and the 48 included species are illustrated with full-color photographs on which important features are clearly labeled. It took Hass and Parrish two years to complete the book. "I had no idea how much work it takes to make something simple," says Parrish. "It's not much work at all to make something difficult."

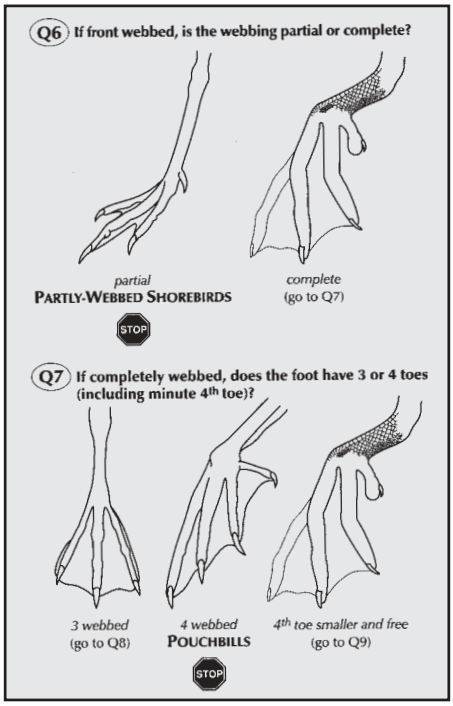
Parrish, a seabird biologist at the University of Washington in Seattle and COASST's Executive Director, got the inspiration for starting the program about four years ago. "I wanted to get a handle on mortality patterns among Pacific Northwest marine bird populations," she says, "and the agencies weren't collecting beached bird data—they just didn't have the resources." Parrish's first step was to conduct "an intensive worldwide search" for other beached bird programs. (Notably, every program she found that collects regular baseline data on beached birds involves volunteers.) After many discussions with leaders of beached bird surveys and other types of volunteer monitoring programs, Parrish came away with a clear sense of what works and what doesn't. Among other things, she became convinced that "the key to a successful program is to make it simple—so that you can count on the data, and the volunteers can count on the fact that what they're doing is correct and meaningful."

IDENTIFYING DEAD BIRDS IS MORE DIFFICULT THAN IT MIGHT SEEM BECAUSE MANY CUES USED TO IDENTIFY LIVE BIRDS—SONG, FLIGHT, BEHAVIOR—ARE NO LONGER AVAILABLE.

Feet first

One way COASST keeps things simple is with a rather unorthodox approach to identification. Identifying dead birds is more difficult than it might seem because many of the cues used to identify live birds—song, flight, behavior—are no longer available, and what does remain may be decomposed, partially eaten, disarticulated, or twisted into strange positions. Hass, COASST's Program and Science Coordinator, starts off training sessions ("Dead Birds 101") with a slide show, first projecting images of live birds which are easily identified by birders in the group. But when he switches to carcasses of the same species, even experienced birders are often stumped.

COASST's solution is to start with the feet—which, being resilient and rather unappetizing, are nearly always present. Volunteers use such characteristics as the number of toes, their size and arrangement, and the degree of webbing to place the bird into one of 16 "foot-type families." From that point, the information and photos in *Beached Birds* lead step-by-step to species identification. "Roger Tory Peterson is probably rolling in his grave," says Parrish—but volunteers love the system. And it works: even though the majority of COASST volunteers are not birders, about 70 percent of carcasses are correctly identified to species and another 20 percent to family, with only 10 percent unidentified.



Sample page from COASST's field guide, *Beached Birds*, showing part of "foot key."

Fit monitoring to data needs

A second lesson Parrish gleaned from her survey of volunteer monitoring groups is that "programs suffer when they start out by asking, 'What kinds of data would volunteers want to collect?' and then try to figure out how to fit those data into science or management needs." In successful programs, she realized, the order is reversed, with the primary, driving question being, "What kinds of data do we need?"

Putting this principle into practice, Parrish focused on the critical information needs for beached bird monitoring: accurate species identification and reli-

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Contact Information

Point Reyes Bird Observatory
4990 Shoreline Hwy.
Stinson Beach, CA 94970
415-868-1221
www.prbo.org

Beach Watch
Gulf of the Farallones National Marine Sanctuary
Fort Mason, Bldg. 201
San Francisco, CA 94123
415-561-6622
farallones.nos.noaa.gov/

Beach COMBERS
Monterey Bay National Marine Sanctuary
299 Foam St.
Monterey, CA 93940
831-647-4204
Kelly.Newton@noaa.gov
www.mbnms.nos.noaa.gov

COASST
School of Aquatic and Fishery Sciences
Box 355020
University of Washington
Seattle, WA 98195
206-221-6893
coasst@u.washington.edu
www.coasst.org

From Ideal to Real

Designing The Ocean Conservancy's Reef Monitoring Program

by Judith C. Lang

FOR THE LAST TWO and a half years, I have been privileged to help invent The Ocean Conservancy's Reef Condition Monitoring Program (RECON). As we took our ideas from our computers to the real world, RECON Project Coordinator Lisa Monk and I found ourselves modifying or even abandoning some of our concepts in a process of "adaptive design" that will no doubt be familiar to anyone who has created and shaped a monitoring program for volunteers.

RECON's beginnings

Though The Ocean Conservancy's International Coastal Cleanup, now in its 17th year, is very widely known, fewer people are aware that since 1989 the cleanup has included an extensive underwater effort. RECON began in response to requests from participants in these underwater cleanups to "do more to help save coral reefs." In 1998, Seba Sheavly, who heads the Conservancy's Pollution Prevention and Monitoring Office in Virginia Beach and is the RECON Project Director, obtained funding from the U.S. Environmental Protection Agency's Office of Water to develop the project, starting in the wider Caribbean region (i.e., all the nations that are within or bordered by the Caribbean Sea or border the Gulf of Mexico, along with the Bahamas and Bermuda).

Seba's goal was to train recreational divers to collect data about the reef environment and the health of important reef organisms at dive sites. This information would serve as a "first alarm" to reef managers and scientists during mass bleaching events or outbreaks of disease and also document positive indicators like the recovery of spiny lobsters or queen conch in marine fishery reserves. The "marching orders" that Lisa and I were given for designing RECON were to complement rather than duplicate any existing volunteer reef monitoring programs, keep the protocols simple, and educate divers about the serious threats to coral reefs.

The overall approach, fleshed out during our first year, was loosely based on the Atlantic and Gulf Rapid Reef Assessment (AGRRA) program that had recently been developed for reef scientists and managers by its organizing committee (of which I am a member). Constant tinkering and tweaking of RECON's basic concepts occurred during trips to southern Florida, St. Croix, Puerto Rico, and the Bahamas, where we gave public slide shows and "drafted" volunteers (dive instructors and their clients, plus local divers) to join us under water. We are gratified that the resulting method is proving to be adaptable to a wide diversity of reef types and diving operations.

TIMOTHY MONK

RECON diver surveys brain coral.

Finding RECON's niche

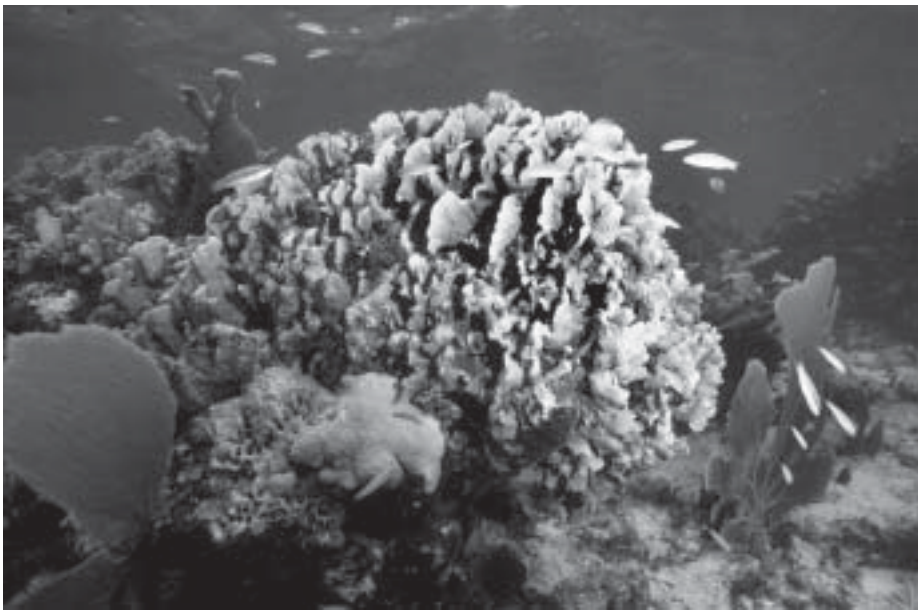
The year before RECON's inception had seen the debut of Reef Check, in which teams of volunteers were being led by marine scientists (or other experts) to collect transect-based data about key fishes, motile invertebrates, and bottom cover. RECON was envisioned as filling a complementary and less technical niche. For example, whereas Reef Check surveys originally took about four hours to complete and involved teams of four to six, RECON was designed to be accomplished by a pair of divers in the course of a single 45-minute dive, without requiring the presence of a trained professional.

An important early decision was to focus our efforts on the bottom-dwelling organisms, particularly stony corals, even though brightly colored, mobile fishes beguile most divers. Lists of fish species and their relative abundance collected by volunteer divers for the Reef Environmental Education Foundation (REEF) already were being posted on the Internet. However, RECON surveys do include observations of several conspicuous "fish effects," such as biting on stony corals. Some parrotfishes remove large chunks from the skeletons of certain mound corals, and selective nibbling by some damselfishes creates tiny lesions wherein the fish "cultivate" algal gardens for food and egg laying. Moreover, large-sized bony fishes have become so rare at many dive sites in the wider Caribbean that REEF Executive Director Laddie Atkins asked us to include sightings of any bony fishes that are more than 0.5 meters long, as well as any sharks, turtles, or dolphins.

Traveling light

Recognizing that few recreational divers have technical diving expertise, Seba instructed us to design a protocol that could be accomplished using nothing more than a slate holding an underwater data card and pencil. Lisa and I soon discovered the wisdom of this approach when many of our first volunteers-in-training dropped their slates as soon as

JOE RICHARD



Reef scene with lettuce coral.

they entered the water. In the end, though, modifications to the protocols (as described below) led us to ask our volunteers to carry one additional piece of "baggage."

Data card design

The REEF staff generously shared with us their expertise in designing data cards for recreational divers. Particularly relevant was learning that volunteers need clear memory aids, such as brief instructions for each task, printed directly on the underwater data card. Our card also includes a reminder to divers to spend no more than half their air supply on the first part of the survey.

Site selection

Whereas individual Reef Check teams, with expert guidance, chose their own monitoring sites, RECON divers would be on their own in the field and I knew we could not expect them to find and describe suitable locations. Hence, to standardize data collection, RECON survey sites are selected and characterized in advance by our staff, certified RECON instructors, or advanced RECON divers.

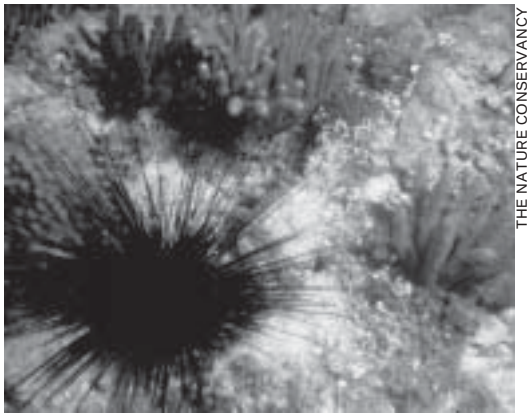
Safety—for divers and for reefs

From the outset, considerations of diver safety led us to limit the surveys to a maximum depth of 18 meters (60 ft.) and a time period of 45–50 minutes, making it possible for recreational divers to easily complete all tasks with a single tank of air.

Our concern for the safety of reef organisms gradually imposed further constraints. Some of our divers had difficulties with controlling their buoyancy and/or maintaining the "head down/feet up" position necessary for avoiding damage to delicate species of stony corals and other fragile marine organisms. Fortunately we have been able to incorporate into our training the Oceanwatch video *Protect the Living Reef*, which provides a clear guide to low-impact diving techniques. Also, the types of stony corals that we use for detailed examination are massive and relatively resistant to accidental breakage.

Stony coral assessment

Health assessments of one of these robust kinds of stony coral constitute the first part of a RECON dive. To select individual corals for detailed observation, divers are instructed to swim four kick cycles without looking down at the bottom, then choose the first coral in front of them that meets certain specifications. From prior experience with AGRRA, I knew that it is virtually impossible to accurately estimate percentages over the entire surface of large corals with complicated, three-dimensional morphologies, such as our volunteers would encounter at some sites. Therefore RECON divers consider only the "top view" when estimating surface area and percent dead or bleached. Then the entire coral is examined for signs of recent mortality due to disease, fish, or other visible calamities.



THE NATURE CONSERVANCY

Long-spined urchin on coral reef in the Florida Keys.

After completing all observations for the first colony, divers repeat the four-kick-cycle process to select up to nine additional corals. Statistically speaking, this method of choice is termed "haphazard." (For a truly "random" selection method we would need to use a randomly chosen number for the kick cycles

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The Ocean Conservancy and Volunteer Monitoring

The Ocean Conservancy (formerly the Center for Marine Conservation) has sponsored the annual International Coastal Cleanup since 1986. Included is an extensive underwater effort, supported by the Project A.W.A.R.E. Foundation (*www.padi.com/aware*). In 2001, more than 1,030 underwater cleanup events took place in 95 countries, making the International Coastal Cleanup the largest conservation effort supported by the dive community. The Conservancy also coordinates the National Marine Debris Monitoring Program, supported by the U.S. EPA Office of Water. Through this effort, rigorous scientific methods are used to collect statistically sound data on marine debris at over 120 sites along the coasts of the United States and its territories.

RECON, continued

between each coral, and swim in a compass direction that had also been determined by a randomly chosen number—all of which would consume far too much of our limited time under water.)

RECON goes quantitative

If the indicator corals can be conceptualized as "trees," the remainder of a RECON dive entails looking around at the "forest." We originally envisioned that as they swam back to their starting area, divers would record the major functional groups of algae present on the bottom and any major perturbations (e.g., bleaching, disease). They would also tally any sightings of diagnostic organisms (e.g., *Diadema*, a key herbivorous sea urchin), marine vertebrates, or trash (e.g., fishing line).

This simple approach was rejected by our Scientific Advisory Committee, who argued forcefully that qualitative habitat information would not be acceptable to the scientific community and directed us to incorporate quantitative data. To accomplish this, we had to add another item—a 10-meter measuring tape—to our volunteers' toolkit. The protocol was radically reformatted to include cover measurements of sand, stony corals, and macroalgae over a linear distance of 10 meters, along with a 20-square-meter belt transect for observing algal functional groups, conspicuous perturbations, specific organisms, and trash.

JOE RICHARD

Sponges (foreground) and great star coral.

Adding these quantitative procedures meant that the training time had to be doubled—from one classroom session and one training dive to two of each. At first we worried about asking our volunteers to make this additional commitment, but we've had no complaints. In fact the second session allows more opportunities for review. We've found that our volunteers master the techniques better and are more confident when they begin conducting their own surveys.

Organism identification

Improving our volunteers' ability to accurately recognize key indicator organisms has been an ongoing process, and is a good example of the value of having time to develop a method before you go public. Wherever we go, I have learned to keep my ears open for whatever divers are most likely to confuse with the stony corals used for health assessments at that location. In some places it's another stony coral, elsewhere it's a soft-bodied animal. Diagnostic characteristics of the organisms that most often cause problems are included in our training materials.

Training and certification

RECON's educational materials (student and instructor manuals, underwater data and training cards, and a qualifying exam) were drafted during my second year with the project. The constructive feedback that we received from 18 "pilot-phase instructors" in the Florida Keys, St. Croix, and Puerto Rico resulted in countless clarifications in the text and improvements to the protocols.

We presented the first formal RECON Instructor training session this Novem-

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Coral Reefs, Bleaching, and Disease

Coral reefs occur worldwide in clear tropical or subtropical waters within about 30° north and south of the equator. Corals are animals that belong to the phylum Cnidaria, which also includes hydras, jellyfish, and sea anemones. RECON surveys are focused mainly on colonial stony corals, which are the primary architects of coral reefs. Because different species of "reef-building" corals have different shapes, such as mounds (e.g., brain and star corals), branches (e.g., elkhorn and staghorn corals), plates, and others, they create numerous nooks and crannies in which myriads of motile animals can seek refuge from their predators.

Stony corals consist of soft, tubular polyps that basally secrete a hard calcium carbonate skeleton that offers the polyps some protection from predation. Some species grow by adding new polyps via asexual reproduction, sometimes creating colonies which contain many hundreds or thousands of interconnected polyps and become at least several meters wide or tall. When, for any reason, some of these polyps die, their exposed skeleton may be colonized by another stony coral or by any one of numerous other sedentary organisms. Under favorable conditions a reef, or large calcareous buildup, with an outer surface partially covered with a thin "skin" of living corals, may eventually form.

Like many other reef-dwelling organisms, stony corals have symbiotic associations with single-celled algae (zooxanthellae) that color and help nourish the polyps. Bleaching represents the loss of these zooxanthellae and/or a reduction in the concentration of their yellow-brown photosynthetic pigments. As a coral's polyps become paler or even colorless, its underlying white skeleton is revealed (hence the term). Bleaching can be induced by many environmental stressors and, when only a temporary condition, is rarely fatal. The mass bleaching events of the last two decades have commonly been associated with unusually elevated seawater temperatures during the warmer months of the year and with calm, clear seas (facilitating increased penetration of ultraviolet radiation). The slow but steady rise of baseline sea surface temperatures in the tropics, increasingly attributed to global warming, is of great concern since coral polyps are likely to die when bleaching is extreme or of long duration.

The number of diseases affecting stony corals (along with many other reef inhabitants) and the frequency of their occurrence have escalated within the last several decades, particularly in the wider Caribbean. Few of the infective agents have been characterized, and little is presently known of their dispersal modes. Simultaneous exposure to other environmental stessors, such as occurs during a mass bleaching event, is widely suspected to enhance the susceptibility of reef organisms to disease.

—Judy Lang

REEF's Fish Survey Project

by Christy Pattengill-Semmens

Only through persistent data collection can researchers and managers gain a comprehensive understanding of the marine environment, yet the monumental task of surveying an immense liquid wilderness is insurmountable without help. The Reef Environmental Education Foundation (REEF) provides help by enlisting recreational divers and snorkelers to collect meaningful information on fish populations.

REEF was founded in 1990 out of a growing concern about the health of marine ecosystems coupled with the desire to provide the diving community a way to contribute to marine conservation. Through REEF's Fish Survey Project, started in Florida in 1993 with the assistance of The Nature Conservancy, volunteer divers collect and report information on marine fish populations.

Fish Survey Project volunteers use the Roving Diver Technique, a visual survey method specifically designed for volunteer data collection. During a survey, divers swim freely throughout a dive site recording every fish species that can be positively identified. The goal is to find as many species as possible. At the conclusion of the survey, each recorded species is assigned an abundance code and the information is transferred to a REEF datasheet. Datasheets are sent to REEF headquarters to be entered into a publicly accessible database available on REEF's Website (*www.reef. org*). By the end of 2001, volunteers had conducted over 40,000 REEF surveys.

The Fish Survey Project now includes the entire tropical western Atlantic (Florida, the Caribbean, the Bahamas, and the Gulf of Mexico), the U.S. East and West Coasts, Canada's west coast, Hawaii, and the tropical eastern Pacific (Gulf of California to the Galapagos Islands).

The goliath grouper (formerly named jewfish) was recently a beneficiary of REEF's database. In the 1980s populations of this huge fish, which reaches up to 700 pounds, dropped sharply, and in 1990 the goliath grouper was protected from all harvest in Florida waters. The moratorium helped the species make a comeback, but there was an increasing lobby to remove its protected status. Resource agencies turned to the REEF database to help decide this critical management issue. Based on REEF data, the Gulf of Mexico Fisheries Management Council determined that it would not be prudent to reopen the goliath grouper fishery now.

REEF

The blue tang is the most frequently sighted fish by REEF surveyors in the Caribbean.

Christy Pattengill-Semmens is REEF's Scientific Coordinator. For more information, contact REEF at 305-852-0030 or reef@reef.org.

Reef Check: A Global Snapshot

ANDY DUNSTAN

Reef Check diver in Australia observes large grouper (*Epinephelus tukula;* locally called "potato cod").

When marine scientists Robert Ginsburg and Gregor Hodgson launched Reef Check in 1997, they conceived of it as a one-time global snapshot—the first attempt to systematically assess reef health on a large scale using a standardized protocol. But that first survey, in which 100 marine scientists and 750 recreational divers collected data on 300 coral reefs in 30 countries during the summer of 1997, proved so popular and successful that Hodgson decided to continue the program as an annual survey.

Reef Check teams typically consist of six divers, including a Team Scientist, who work in pairs to complete belt transect surveys for fish and invertebrates and a line transect survey of substrate type. Different lists of indicator species have been developed for the Indo-Pacific, the Caribbean, the Red Sea, and Hawaii.

The program currently involves over 1,000 volunteers surveying some 500 reefs in more than 50 countries and territories. The basic Reef Check methods have been adapted to fit local needs in various parts of the world and are sometimes used to conduct regular ongoing monitoring in addition to the annual survey. For some sites, Reef Check is the sole source of information on the status of local reefs.

Truly a global network, Reef Check is headquartered at the University of California at Los Angeles (UCLA) with offices in Hong Kong, Thailand, and Indonesia as well as National Coordinators in most participating countries. Data sheets from all surveys are compiled and analyzed at the UCLA office.

For more information, including a PDF version of the *Reef Check Survey Instruction Manual*, visit *www.reefcheck.org* or contact Reef Check headquarters at 310-794-4985; *rcheck@ucla.edu*.

Sea Stewards
Monitoring Protected Zones in the Florida Keys

by Brian D. Keller

ACADEMIC AND GOVERNMENT scientists are not the only people monitoring marine ecosystems in the Florida Keys. REEF volunteer divers have conducted fish surveys here for nearly a decade (see page 17), and in 1998 volunteers with The Nature Conservancy's Sea Stewards program began monitoring the effects of no-take zones in the Florida Keys National Marine Sanctuary (FKNMS). An innovative aspect of the sanctuary's management plan is a network of 24 fully protected zones designed to protect biodiversity and sensitive habitats and reduce user conflicts. Inside these "no-take" zones diving and boating are permitted but all forms of fishing or collecting, including collection by divers, are prohibited. The fully protected zones cover approximately 6 percent of the 9,850-square-kilometer sanctuary, but protect 65 percent of shallow bank reef habitats and 10 percent of coral resources overall.

Tracking the effects of protection

First-order effects of full protection are relatively easy for scientists to predict and measure: we expect to see increases within the fully protected zones in both population abundance and individual size for species that were formerly exploited at these sites. These effects have been documented in fully protected marine reserves in other parts of the world and are starting to become evident in the FKNMS for some heavily fished species such as snappers, groupers, and spiny lobster.

As predators increase in size and number (a first-order effect), second-order ecological effects may become apparent in the form of decreases in prey populations such as small reef fish, juvenile stages of large reef fish, and various invertebrates (crustaceans, snails, sea urchins, and other groups). And then there are possible third-order effects, and beyond—but most ecologists draw the line at third-order. Second- and third-order effects of protection are more difficult to predict and measure than first-order effects, particularly in tropical systems with hundreds of common species and multitudes of ecological interactions.

KAY PARTCH

Brian Keller accompanying a Sea Stewards team.

In the FKNMS, as in most other places where marine protected areas have been established, academic and government programs are mainly focused on studying first-order effects of protection, as well as overall effects such as changes in composition of coral reef communities or changes in human uses and perceptions. The most important information gaps are mainly in the realm of second- and third-order effects. To fill these gaps, The Nature Conservancy (TNC) of the Florida Keys created the Sea Stewards program. Our goal was to train volunteer divers as underwater scientists whose data would be accepted by the larger research community. As TNC's Marine Ecologist at the time, I helped launch Sea Stewards in 1998 after a year of intense planning and preliminary testing.

Sea Stewards consists of 10 volunteer teams of two to six divers. Each team is assigned a pair of sampling sites, one inside a fully protected zone and the other outside. The use of permanent, paired sampling sites is a cornerstone of the program. This design enables Sea Stewards volunteers to get to know their sites better than anyone else, making them more aware of both seasonal patterns and longer-term ecological changes.

There are two seasons in the Florida Keys: a dry season (November through April) and a wet season (May through October). Data are collected once during each season. Sea Stewards are also encouraged to dive on their sites as often as possible to make general observations.

Selecting "targets"

A critical step in designing Sea Stewards was selecting suitable ecological indicators, or "targets," for the volunteers to monitor. We needed to identify targets that would zero in on possible

The Florida Keys are home to the largest living coral reef in the continental United States. To protect this vulnerable ecosystem, Congress designated a portion of the Keys as one of 13 marine environments protected and managed through the National Marine Sanctuary Program (*www.sanctuaries.nos.noaa.gov/*). The U.S. National Oceanic and Atmospheric Administration and the State of Florida manage the sanctuary under a comprehensive management plan that was implemented in 1997.

second- and third-order effects, thereby complementing other ongoing research efforts. At the same time, we wanted to make sure the targets were not too difficult for volunteers to find and identify. Based on numerous discussions with FKNMS staff and academic and government scientists, we selected four targets that met our criteria:

1. All species of reef-dwelling sea urchins, which in the FKNMS consist mainly of the long-spined urchin, slate-pencil urchin, reef urchin, and rock-boring urchin.
2. Adult threespot damselfish.
3. Juvenile and adult yellowtail damselfish.
4. All species of fish cleaners, which include the neon goby, Pederson cleaner shrimp, spotted cleaner shrimp, scarlet-striped cleaner shrimp, juvenile porkfish, juvenile Spanish hogfish, and juvenile bluehead wrasse.

Because the different targets play different roles in the Keys ecosystem, Sea Stewards teams will be able to reveal different effects of protection.

We selected sea urchins because of their role in grazing bottom-dwelling algae. Moderate levels of sea urchin grazing benefit corals by preventing algal overgrowth. Sea urchins generally are not abundant in the FKNMS, in part because the formerly abundant long-spined urchin still has not recovered from a 1983 Caribbean-wide mass mortality. Predation on juvenile sea urchin stages by several kinds of reef fish may be an important factor in keeping urchins scarce. At this point we cannot predict whether sea urchin populations will increase or decrease within the protected zones or whether effects will be different for different urchin species. We hope that the data collected by Sea Stewards will help improve our understanding.

The damselfish species selected as targets are prey for larger species such as snappers and groupers, so we expect to see a second-order effect of declining damselfish populations in protected areas as their predators increase. The adult threespot damselfish are of particular ecological importance because they are strongly territorial and defend "gardens" of algal species they prefer to eat. Threespots damage live coral both directly, by nipping away coral tissue, and indirectly, by the smothering effects of their algal gardens. We expect to see less of these kinds of detrimental effects within fully protected zones.

THE NATURE CONSERVANCY

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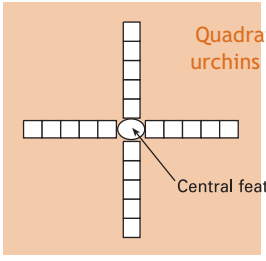
Above: Moray eel at cleaning station being cleaned by a neon goby (between eyes).
Left: Threespot damselfish. Fish cleaners and threespot damselfish are among the Sea Stewards targets.

The various fish cleaners pick parasites and other material off the skin, mouths, and gill chambers of larger reef fish "clients." Cleaners often wait at stations such as coral heads, where they may "advertise" their presence by their appearance or behavior: many are brightly colored, some have long white antennae, and some perform characteristic movements when potential clients are near. Since some cleaner species are collected for the aquarium trade, we expect that their populations may increase within fully protected zones where they are free from collection. Cleaner populations should have the potential to increase even further as client fish populations increase.

How targets are monitored

Sea urchins and the targeted damselfish are identified and counted in 20 1-square-meter quadrats radiating out from a central feature in four belts of five quadrats each (see diagram). Fish cleaners, clients, and active cleaning stations are identified and mapped in four 100-square-meter belt transects radiating out from the central feature. All data are recorded on special underwater datasheets.



To help volunteers with identification, we prepared plastic cards for underwater use. One card has color photos of sea urchins; the other has photos of the most common fish cleaners. On the reverse of the sea urchin card are circles of different diameter for use in assigning urchins to size categories.

Findings

The findings of the Sea Stewards program are presented at annual meetings. To date, none of the four targets has shown a statistically significant difference between fully protected zones and reference areas. However, the zoning program was only implemented in 1997, so it may be premature to see clear-cut patterns. If population changes occur in any of the targets, Sea Stewards may be among the first to know.

Brian Keller is the Science Coordinator for the National Oceanic and Atmospheric Administration's Florida Keys National Marine Sanctuary and the former Marine Ecologist with The Nature Conservancy. For more information, visit www.fknms.nos.noaa.gov/ *or contact Mary Enstrom at The Nature Conservancy of the Florida Keys, P.O. Box 420237, Summerland Key, FL 33042,* menstrom@tnc.org; *305-745-8402 x 110.*

Salinity Methods Comparison:

Conductivity, Hydrometer, Refractometer

by Peter Bergstrom

VOLUNTEER MONITORS HAVE a choice of four commonly used methods for measuring salinity: hydrometer, refractometer, chemical test kit (based on chloride titration), or digital conductivity meter. Almost all researchers and professional monitors use conductivity meters, but most volunteer groups use one of the other methods because meters are expensive. Since volunteers and professionals are mostly using different methods to measure salinity, the issue of comparability of results needs to be addressed.

In *The Volunteer Monitor* Spring 1997, I reported the results of a study comparing salinity by hydrometer and conductivity in the Magothy River.[1] This article reports on a more recent study comparing three salinity methods (hydrometer, refractometer, and conductivity meter) in two sub-estuaries of Chesapeake Bay. I plan to conduct similar studies with the chloride titration kit in 2002.

The parallel testing data reported in this article were collected from 1997 through 2001 at four tidal stations on the Magothy River, which drains into Chesapeake Bay between Baltimore and Annapolis, and in 2001 at four tidal stations on Breton Bay in southern Maryland, which drains into the Potomac River near its mouth. The Magothy River stations were either on the mainstem of the river or near the mouth of a tidal creek.[2] The Breton Bay stations were all on the mainstem of the river.

Conductivity was measured with a Hydrolab model III, IV, or Quanta (all of which automatically calculate salinity from the conductivity reading). The hydrometer was from LaMotte, labeled 60/60 F, and the refractometer was a Vista Model A366ATC. The Hydrolab was calibrated with a conductivity standard before each day of sampling and the refractometer was rinsed and calibrated regularly with distilled water. In all cases the hydrometer and the refractometer were used on water from the same bucket taken from the surface layer, and compared to a conductivity reading taken at the same time at the same site from the surface layer (0.1 meter depth).

Salinity (as measured by conductivity meter) ranged from 0.5 to 14 psu in the Magothy River and from 5 to 17 psu in Breton Bay. This range, which extends up to about half the salinity of seawater, is the lower end of the possible range of salinity in estuaries.

> Salinity is now defined in terms of conductivity, not as a concentration of dissolved solids. As a result of this change, the units are now called "practical salinity units" (psu), rather than parts per thousand or ppt. The measurements are equivalent: 10 ppt is now 10 psu.

Results

Magothy River. In the Magothy River, the hydrometer and refractometer performed about equally well in terms of both accuracy and precision (Figures 1 and 2). With both methods, salinity measurements averaged about 1 psu higher than salinity measured by conductivity, and this difference was fairly consistent over the salinity range.[3]

Breton Bay. Although the hydrometer results in Breton Bay were fairly accurate at higher salinity (above 14 psu), they averaged about 3 psu higher than conductivity results at salinities below 8 psu as measured by conductivity (Figure 3). For the Breton Bay measurements the refractometer was more accurate; that is, it matched the conductivity results more closely than did the hydrometer (Figure 4). Precision was about the same as in the Magothy data.

Thus, there was a larger difference in accuracy between the hydrometer and refractometer in the Breton Bay data than the Magothy River data. This was probably due to higher concentrations of total suspended solids (TSS) in Breton Bay. The hydrometer measures specific gravity, which is affected by the concentration of both suspended and dissolved solids. Since salinity is due to dissolved solids only, the presence of suspended solids makes hydrometer salinity readings higher, especially at lower salinity where the added weight from TSS has more effect. The refractive index measured by the refractometer is only affected by dissolved solids, so it is not subject to bias from TSS.

Which method should you use?

The three methods used in this study vary in cost, ease of use, and accuracy. Unfortunately, the most accurate and easiest method—the conductivity meter—was also the most expensive. Meters cost anywhere from $700 up to $3,000, depending on whether other parameters are included; and there are ongoing costs for conductivity standards, batteries, and repairs. Pocket conductivity meters are available for less than $100 but lack the range to measure salinity above about 10 psu, which limits their utility. The refractometer (about $150) is more expensive than a hydrometer ($25, including jar). However, there are ongoing costs to replace broken hydrometers.

[1] "Salinity by Conductivity and Hydrometer: A Method Comparison"; available online at *www.epa.gov/volunteer/spring97/*. (Note that the adjustment equation was printed incorrectly. It should have been CS = (HS - 1.9807)/0.9257.)

[2] Data from two Magothy River stations located farther up two small tidal creeks are available from me by request. The results were not very different from the Magothy River data.

[3] The Magothy River hydrometer results were similar to those reported in my 1997 article, which was based on 1993–1996 data. Accuracy was slightly higher in the recent data.

Compared to the meter, both the refractometer and the hydrometer are quite hard to read. Those helping me often decline to try to read them, but are glad to read the meter. I found the refractometer slightly easier to use than the hydrometer because it is smaller and less fragile; it needs only a few drops of water; it is easier to read on a moving boat; it is temperature compensated; and it reads salinity directly, avoiding the possibility of errors in calculation. On the down side, a refractometer is easier to lose, especially if dropped in the water; and it needs to be calibrated regularly with distilled water, while the hydrometer does not.

The required level of accuracy depends on the anticipated data uses. Volunteer monitors measure salinity for a variety of reasons. Some want to get a general idea of what salinity zone they are in, or how salinity changes along the length of an estuary or in response to rainfall. For this type of study, in which comparisons are made over space or time with other data collected by the same method, the method is less critical and choice can be based on cost and ease of use.

Other volunteer programs have more specific questions related to living resource restoration; for example, Which species of submerged aquatic vegetation (SAV) can survive the salinity range in the creek where I sample? or, Will the salinity range in my creek support survival, spawning, and spat set of oysters, and how likely are they to become diseased? For answering questions like these, accuracy and precision are more important. A meter would obviously be ideal, but if it is too expensive, the refractometer should provide more reliably accurate results than the hydrometer. In both the Magothy River and Breton Bay, I found the refractometer's accuracy to be within the range needed for such studies (i.e., within 1-2 psu on average of conductivity results). In contrast, the level of accuracy that I found with the hydrometer in Breton Bay would not be acceptable.

In cases where obtaining salinity data that are consistently comparable to professional results is an important goal, a conductivity meter is the best option.

LIZ BERGSTROM

Peter Bergstrom demonstrates use of refractometer. In his left hand he is holding a hydrometer.

Salinity Method Comparison Results

Magothy River 1997-2001

Fig. 1. Hydrometer

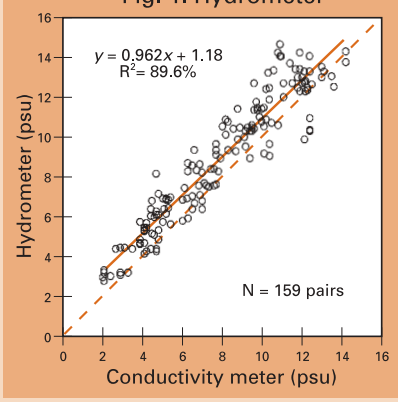
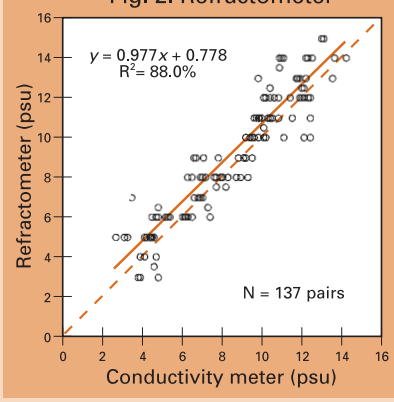


Fig. 2. Refractometer



Breton Bay 2001

Fig. 3. Hydrometer

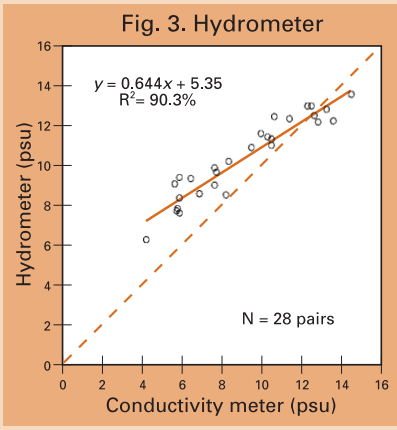
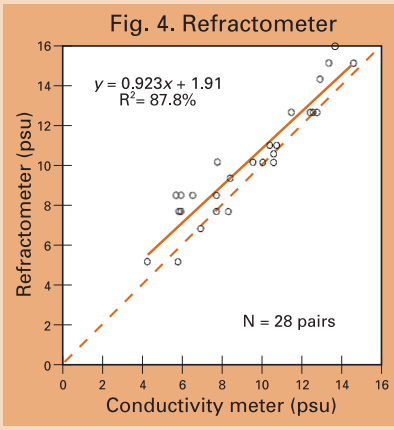


Fig. 4. Refractometer



The graphs shown here are scatter plots of paired data points. In each plot, a method (either hydrometer or refractometer) is being compared to conductivity, which is considered the "gold standard." If there were perfect agreement between two methods, all the points would lie along a straight line with a slope of 1 and an intercept of 0. This ideal line, whose equation is $y = x$, is indicated by the dashed line on the plots. The solid line on the plots shows the "best fit" line based on the actual data. The regression equation shown for each plot is the equation for this line.

The *y*-intercept and slope of the regression line are measures of accuracy of the given method compared to conductivity. A slope close to 1 and a *y*-intercept close to 0 indicate a high degree of accuracy.

The regression coefficient (R^2) value is a measure of precision (visually, the amount of "scatter" on the plot). Higher precision will be reflected in a plot with very little scatter and an R^2 near 100%. A lower R^2 means lower precision (more scatter).

Peter Bergstrom is a biologist with U.S. Fish & Wildlife Service in Annapolis, MD, and the volunteer monitoring coordinator of the Magothy River Association (www.magothyriver.org). *He may be reached at* peter_bergstrom@fws.gov *or 410-573-4554.*

Large-Scale Monitoring Events

Each year, volunteer monitors have several opportunities to participate in national or international monitoring or cleanup events. Mark your calendar now for these dates in 2002, and visit the Websites for more information and to preregister and receive materials.

May 11–18: National River Cleanup Week (started 1992). *www.americaoutdoors.org/nrcw/*; 865-558-3595.

June 29–July 14: Great North American Secchi Dip-In (started 1993). *dipin.kent.edu.* Transparency measurement by Secchi disk, turbidity tube, turbidity meter, or black Secchi disk in rivers, streams, estuaries, or lakes.

July (whole month): Great Annual Fish Count (started 1992). *www.fishcount.org/.* Fish census by volunteer divers and snorkelers.

Sept. 21: International Coastal Cleanup (started 1986). *www.theoceanconservancy.org.* Volunteers clean up lake, river, and ocean shorelines and collect data on the amount and types of debris they collect.

Oct. 18: National Water Monitoring Day; *www.yearofcleanwater.org* (see article on page 2 for details).

Dec. 14–Jan. 5: Christmas Bird Count; *www.audubon.org/bird/cbc/.* This event has taken place every year since 1900!

BEACHED BIRDS, continued from page 13

able determination of deposition rate (the rate at which dead birds wash ashore) and persistence rate (the length of time a carcass remains on the beach, an indicator of the amount of scavenging). To assure that these needs would be met, Hass and Parrish built into COASST some extra procedures not generally included in beached bird surveys. Besides photographing each carcass, COASST volunteers make and record three specific measurements of the beak, wing, and leg. This additional information helps COASST staff verify the volunteers' identifications. Another COASST innovation is a coding system using colored tags to uniquely identify every carcass. This prevents recounting the same carcass (which would skew the deposition rate) and also allows calculation of persistence rate. "So far," says Parrish, "we're the only program that has reliable data on persistence rates, because we tag our birds."

Expansion

In just two years, COASST has grown to include over 100 volunteers monitoring some 60 beach segments, exceeding Parrish's original goal. Now the program is expanding into Oregon through a new partnership with Oregon's CoastWatch. Nearly 1,000 volunteers strong, CoastWatch covers the entire Oregon coastline with its "Mile-By-Mile" program, whose participants conduct basic observational monitoring along mile-long segments at least four times a year. "The partnership is a good fit," says CoastWatch Coordinator Phillip Johnson. "CoastWatch is useful for alerting scientists to problems, but we don't collect data that scientists can use directly. A subset of our volunteers who want to participate directly in gathering scientific information has reacted very enthusiastically to the COASST program."

The rewards

Of course COASST volunteers, like beached bird monitors everywhere, are motivated by the knowledge that they are contributing data for science and conservation, but there are immediate personal rewards as well. "Some of our volunteers are people who've been walking their beach for 10 or 20 years, but through COASST they've discovered species they never realized were there," says Parrish. "It's an eye-opening experience, like realizing you've been in another world and never even knew it. At a basic level that's what science is all about—discovering that other world that's right in front of us."

Resources

Ainley, D.G., et al. 1993. *Beached Marine Birds and Mammals of the North American West Coast: A Revised Guide to Their Census and Identification, with Supplemental Keys to Beached Sea Turtles and Sharks*. NOAA; GFNMS. Available from the Farallones National Marine Sanctuary Association, 415-561-6625; *www.farallones.org*; $29.95 + S&H.

Hass, T., and Parrish, J. 2000. *Beached Birds: A COASST Field Guide*. Seattle: Wavefall Press. To order, contact COASST at 206-221-6893; *coasst@u.washington.edu*.

RECON, continued from page 16

ber in Key Largo, Florida. Our certification system—another concept adapted from REEF—allows progression from RECON I diver through RECON III diver, and finally to RECON Instructor. Advancement is based on instruction received, number of surveys conducted, and examination scores.

Thanks to a grant from NOAA's Office of Coastal Zone Management, we recently teamed up with some of REEF's staff to offer joint training workshops to local divers in Puerto Rico and the U.S. Virgin Islands; a third session is scheduled in San Andrés, Colombia, in June 2002. After several days of intensive training, with up to four dives per day plus evening sessions, successful participants are qualified as both RECON I and REEF Level 2 divers.

As I write, the final print materials (manuals and cards) are being readied for publication. Photographic illustrations will be available in the spring (initially as slides, later as a CD-ROM). Although much has been accomplished to date, the real challenge for RECON is yet to come, as the program is built to collect, interpret, and disseminate sound information about ecosystem changes on coral reefs.

Judith C. Lang is a coral reef scientist with experience in rapid reef assessment, outreach education, and volunteerism. For more information about RECON, contact Project Coordinator Lisa Monk at The Ocean Conservancy; recon@oceanconservancyva.org; *757-496-0920.*

Video

Protect the Living Reef, produced by Cliff McCreedy of Oceanwatch; to order see *www.protectreefs.org*. Cost: $5.

Websites

AGRRA: coral.aoml.noaa.gov/agra/
The Ocean Conservancy:
www.oceanconservancy.org/
EPA's Coral Reef Program:
www.epa.gov/OWOW/oceans/coral/

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Water Quality Monitoring Council Conference

The Third National Water Monitoring Conference will be held May 20-23, 2002, in Madison, Wisconsin. Sponsored by the National Water Quality Monitoring Council and its member organizations, the conference is titled "Water Quality Monitoring 2002: Building a Framework for the Future." While this is not specifically a volunteer monitoring conference, the conference agenda includes sessions focusing on volunteer monitoring plus a special half-day workshop on large-scale volunteer monitoring events. The work of volunteers is also highlighted in a variety of posters and presentations throughout the conference.

The conference will explore collaborative efforts, highlight new and emerging technologies, examine changing expectations of monitoring, and share results and successes. Volunteer monitoring program coordinators are encouraged to attend, learn from the professionals, and, equally important, teach those same professionals a thing or two . . .

Two Volunteer Monitor editorial board members, Linda Green and Abby Markowitz, are serving on the conference planning committee. Please feel free to contact Linda *(lgreen@uri.edu)* or Abby *(Abby.Markowitz@tetratech.com;* 410-356-8993) if you have any questions about the conference; or visit the conference Website at *www.nwqmc.org.*

Lakes Conference: Invasive Species

The 15th annual conference of state's lake program managers, to be held April 23–26 in Chicago, will focus on managing invasive species in lakes and reservoirs. Government agency staff, lake association leaders, scientists, and others will share their successes—and failures—using biological controls, chemical agents, public education programs, and more. The conference includes a session on the role of volunteer monitors.

For registration information and program brochure contact conference coordinator Bob Kirschner, *bkirschn@chicagobotanic.org.*

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River Network
520 SW 6th Avenue, Suite 1130
Portland, OR 97204-1511

Resources

Beginner's Guides for Lake Monitors

Florida LAKEWATCH has completed three new information circulars—"Water Clarity," "Lake Morphometry," and "Symbols, Abbreviations, and Conversion Factors"—in its continuing series, *A Beginner's Guide to Lake Management.* Each 32-page booklet presents comprehensive information in easily understood language. The new titles, as well as two earlier circulars ("The ABCs" and "Nutrients"), may be downloaded in PDF format from *lakewatch.ifas.ufl.edu/Lwcirc.html;* or call 352-392-9617 x 228, for a print copy.

QAPP Guidebook

To assist volunteer monitoring programs in developing Quality Assurance Project Plans (QAPPs), the Massachusetts Department of Environmental Protection (MDEP), in conjunction with the Massachusetts Water Resources Research Center, has recently completed *The Massachussetts Volunteer Monitor's Guidebook to Quality Assurance Project Plans.* The 100-plus-page book, which can also be used by programs outside of Massachusetts, covers the 24 elements presented in EPA's 1996 guidebook, providing additional information and examples for each element. The MDEP guidebook is available at *www.state.ma.us/dep/brp/wm/wmpubs.htm#em,* or in hard copy from Arthur Screpetis at *arthur.screpetis@state.ma.us.* (*Note:* For a copy of the 1996 EPA document, *The Volunteer Monitor's Guide to Quality Assurance Project Plans,* call NSCEP at 800-490-9198 and ask for EPA 841-B-96-003.)

Conference Proceedings on Web

The Proceedings of the 6th National Volunteer Monitoring Conference (held in Austin, Texas, in April 2000) are now available online at the Environmental Protection Agency's volunteer monitoring Website, *www.epa.gov/owow/monitoring/vol.html.* Print copies may be ordered from NSCEP, 800-490-9198 (order EPA 841-R-01-001).

Earth Force GREEN Website

The new Earth Force GREEN (Global Rivers Environmental Education Network) Website, *www.green.org,* allows educators and young people to enter, analyze, and share data; access interactive maps and resources; download classroom activities; and create their own customized Web pages.

Wild Earth Citizen Science Issue

The latest issue of *Wild Earth,* the quarterly publication of the Wildlands Project, features a special "Citizen Science" section. Topics include surveys of birds, butterflies, frogs, and reef fish; wild mammal tracking; volunteer vs. professional macroinvertebrate data (reprinted from *The Volunteer Monitor)*; and an essay on the difference between "citizen scientists" and "amateur naturalists." Order vol. 11, no. 3/4 at the special sample price of $3 from the Wildlands Project (Richmond, VT); 802-434-4077; *info@wildlandsproject.org.*