

Action Plan 20. Monitoring Management Action, Status and Trends

Problem

Monitoring is to track the effectiveness of management action or inaction. For Clean Water Act initiatives like the National Estuary Program, a key question has always been, are we making waters more fishable and swimmable? This question is understood as whether government is preserving and protecting ecosystem health and the integrity of the natural environment, and whether waters meet specified "designated uses." An especially difficult challenge in all environmental monitoring programs is recognizing that static environmental conditions in the face of new development or pollution inputs is in itself a measurable success.

Increasingly, funding agencies want to know not only whether a project was completed successfully, but also whether it was successful in protecting or restoring the environment. In fact, the 1987 amendments to the Clean Water Act section 320(b)(6) specified that each NEP Management Conference shall "...monitor the effectiveness of actions taken pursuant to the plan," to meet these two goals: "measure the effectiveness of the management actions and programs implemented under the [CCMP]; and provide essential information that can be used to redirect and refocus the CCMP during implementation." Implicit in these requirements are programmatic monitoring, environmental monitoring, and some level of research to ensure that selected environmental monitoring is adequately characterizing environmental conditions and risks.

Each action plan in the CCMP includes monitoring strategies. This action plan reiterates some of the most important elements of other action plans, but also addresses some broader watershed monitoring and reporting needs to meet the broader goals of the CCMP.

Goals

Goal 20.1. To document environmental trends of water quality and living resources in order to assess the effectiveness of management actions taken, or identify the need for new actions.

Goal 20.2. Identify research and monitoring needs to better understand the causes of impairments and to resolve uncertainties about the health and condition of Buzzards Bay.

Objectives

Objective 20.1. Collect and monitor programmatic actions to document implementation of CCMP recommended actions.

Objective 20.2. Ensure that regulatory agencies define essential monitoring requirements and collect data necessary to evaluate program and project success.

Objective 20.3. Ensure that funding is available to implement essential monitoring programs.

Objective 20.4. Revise and adapt monitoring programs to meet changing needs and information gaps.

Objective 20.5. Disseminate data and syntheses of information to scientists, managers, and the public.

Objective 20.6. Encourage scientists and agencies to evaluate emerging contaminants and other stressors to the environment.

Solutions

Shellfish bed closures, eutrophication data, and eelgrass bed cover are some of the key water quality measures that must be tracked, but in the long run, the state's list of impaired waters (as river miles and water acres) will be the ultimate measure of success of actions taken to comply with the Clean Water Act. This also means considerable effort will be needed to monitor and characterize the many unassessed freshwater and marine bodies in the bay and watershed.

While programmatic and environmental data are collected by the U.S. EPA, the Buzzards Bay Coalition, Buzzards Bay NEP, DEP and the EPA, more effort is needed to make this information available on line, and where needed, synthesizing and aggregating data to show watershed comparisons and trends in time.

Programmatic actions by municipalities to comply with permits and watershed TMDL goals are both short term and long term measures to be tracked. Government will need to expand funding to research institutions to enable managers to better discern threats from emerging issues and concerns.

Costs and Financing

Tracking programmatic actions have modest costs. The cost of field monitoring described in the various action plans in the CCMP may total hundreds of thousands of dollars annually. Some monitoring needs can be met through new permit requirements, research grants may assist in evaluating contaminants of emerging concern, or federal watershed assessment grants (604b), but most monitoring costs must be borne by agencies managing the environment.

Measuring Success

Whether or not sufficient information exists to evaluate the success of each action plan in this CCMP will be the measure of success for this action plan.

Background

Monitoring is often a requirement in environmental permits and environmental grants. It is also an essential need to evaluate the progress or success of environmental initiatives or programs. In recent years, there has also been an increasing trend to evaluate the success of public expenditures, thus in 1993, Congress passed the Government Performance and Results Act (GPRA) "to provide for the establishment of strategic planning and performance measurement in the Federal Government." Fifteen years later, the implementation of this law is still evolving and changing how federal agencies, and federally funded state agencies, gather information to evaluate the performance of programs and how they monitor the environment. The Act required federal programs to identify measurable goals for tracking progress towards the agency's mission. To answer such a fundamental question, each program needed to adopt performance indicators that were objective and valid.

To meet elements of the U.S. EPA's compliance with the GPRA, all the NEPs now track CCMP actions completed, and acres of wetland and habitat protected and restored. Beyond these minimum requirements, each NEP is responsible for developing and implementing a monitoring program to track both programmatic actions recommended within a CCMP, and measures to document water quality, habitat, populations, and measures of ecosystem health and integrity.

There are two fundamental challenges faced by any program attempting to meet such goals. The first of these is cost. In the original Buzzards Bay CCMP a "tiered monitoring program" was developed to answer and address a wide variety of issues of water quality and habitat. Full implementation of the recommendations might have cost millions annually. Some entities successfully implemented monitoring initiatives. These included DEP's eelgrass monitoring program, DEP's wetland change program based on the analysis of aerial photographs, and the water quality monitoring program created by the Buzzards Bay NEP to evaluate the impacts of nitrogen loading and coastal eutrophication. The BBPNEP established and funded this latter program, established as a citizen based monitoring program in partnership with the Buzzards Bay Coalition (then called the Coalition for Buzzards Bay). The Buzzards Bay Coalition assumed all management of the program by 1997, and in the late 1990s, the Massachusetts legislature became the principal sponsor of the citizen monitoring program, first by providing \$100,000 annually, then \$150,000 annually by the mid-2000s. By 2008, when a budget crisis eliminated funding for the program, the Coalition had begun to put in place an endowment fund to help the citizen group maintain this popular program.

However many other recommendations in the original CCMP monitoring plan were not implemented because state and federal funding for monitoring programs diminished greatly through the 1990s and 2000s. For example, bay wide monitoring of PCBs and other toxic constituents in seafood in Buzzards Bay to document the effectiveness of state and federal efforts clean up the New Bedford Harbor superfund site ceased¹¹⁷. Other federal programs like the Mussel Watch program continued with reduced frequency of monitoring and analyte testing. These programs were once deemed essential to monitor effectiveness of efforts to reduce toxic discharges from point and non-point sources. Other recommendations in the CCMP monitoring plan were never funded.

Similarly, efforts to monitor and identify upstream sources of bacteria, or to evaluate stormwater discharges to establish priorities for remediation were never implemented in a systematic way because of high costs and the lack of funding at any level of government. The Buzzards Bay NEP, municipalities and the Buzzards Bay Coalition have attempted to address the latter issue within specific projects, but these actions have been piecemeal. In some respects the Phase II stormwater TMDL program should address some unmet needs because municipalities are required to evaluate discharges as part of their municipal stormwater systems and networks, but municipalities are also facing serious budget shortfalls, and water quality testing may remain a low priority for some time.

Besides the lack of funds to implement additional monitoring programs is the fact that there are many challenges to interpreting monitoring data and communicating the results to both the public and managers. The cost of synthesizing information and translating data into understandable findings conveyed through various communications media can sometimes exceed the cost of data collection and laboratory analysis.

In addition to the cost of data synthesis, the results of monitoring program may fail to show clear trends. This is often the case because changes in pollutant discharges are small relative to background levels, other sources, or natural variability. In particular, seasonal rainfall amounts greatly affect those pollutants conveyed through stormwater runoff and ground water flow. For example, when evaluating eutrophication impacts, seasonal rainfall amounts strongly affect eutrophication indicators. Even if changes in land use or sewerage result in theoretical increases or declines in

¹¹⁷ The original monitoring plan recommended that PCB measurements be "repeated every 5 years in the outer harbor following remediation." Cleanup contractors cleaned up the Superfund site PCB hotspots were removed by 2001, but the lower level contaminated areas are now gradually being excavated and transferred to landfills outside of Massachusetts. This last part of the PCB cleanup may not yet be complete for another twenty years.

nitrogen loading over a period of time, invariably during wet summers, eutrophication indicators will show poor water quality in most embayments, whereas during a drought summer water quality may become exceptional.

Major issues

Financial and personnel Constraints

Information needs by government to help protect the environment often exceed the financial and staffing capacity of agencies and universities.

Conveying information

Even for data that is available, synthesizing and communicating effectively to the public can be time consuming and sometimes expensive. Adding to the problem, multiple entities collect data on different pollution measures, with sometimes contradictory trends, making it difficult to communicate a clear message with a simple "story."

In the case of nitrogen loading, this problem led the Buzzards Bay NEP to create the Eutrophication Index for the Buzzards Bay Coalition citizen monitoring program in 1992, combining five different parameters (chlorophyll, secchi depth, inorganic nitrogen, organic nitrogen, and oxygen concentrations) into a single water quality index. The Buzzards Bay Coalition adopted a similar approach by creating scores for a series of other numeric indicators for its State of the Bay reports beginning in 2001. This technique allowed the establishment of a single Bay Health Index cutting across numerous water quality and living resource issues. Environmental programs have increasingly adopted these approaches across the U.S. and elsewhere.

A non-trivial subset of problems with communicating environmental trends is the fact that there has been a substantial increase in population and development and a dramatic loss of natural habit in the coastal zone in the last 20 years. If certain water quality indicators remain steady in the face of these trends, this is in fact a management success. However, getting funding agencies and the public to appreciate such realities has been difficult at best.

A more disturbing impediment to the development and funding of new monitoring programs is that government often does not want to document the extent of existing or new problems. In this context, monitoring the environment is seen neither as an investment, nor as a mechanism to build a healthy economy. More rigorous monitoring can close swimming beaches, discourage tourism and recreation, and cost government and industry money by exposing problems that cost money to solve. An extension of this logic is that it is more appropriate to use limited government funds and budgets to solve problems already documented by earlier

monitoring efforts than to implement new monitoring programs.

Programmatic versus field monitoring

In recognition of the financial constraints of monitoring, challenges in interpreting and communicating the results of the monitoring programs, and the practical aspects in detecting modest trends in the face of a noisy environment impacted by increasing development, certain compromises must be made to create a meaningful program to track the progress and effectiveness of the Buzzards Bay CCMP.

For example, monitoring the effectiveness of management actions on the shifting shoreline action plan is best tracked by regulatory and non-regulatory management actions taken. Perhaps the true effectiveness of actions taken in preparation of catastrophic storm flooding can only be judged after the another category 3 hurricane (like the hurricane of 1938) strikes Buzzards Bay, but even then each storm presents unique circumstances that define its effects. Similarly, the success of management recommendations in Managing Water Withdrawals Action Plan will best be judged by tracking municipal per capita water use. In fact, throughout the action plans, programmatic and management action monitoring is the principal tracking mechanism.

Other measures of the environment, like eelgrass habitat area, wetland area, endangered species population counts, bacteria concentrations (and the documentation of resulting beach and shellfish bed closures), and eutrophication indicators will remain the direct indicators of overall ecosystem integrity, program success, and the effectiveness of government actions.

As was the case with the original CCMP monitoring plan, because most water quality and living resource problems around Buzzards Bay are highly localized and related to local land use around each embayment (and because conditions in the central bay are generally good), this monitoring action plan remains focused on evaluating water quality and living resources within the context of coastal embayments and their contributing watersheds. The action plan also supports efforts to monitor the effectiveness of individual projects and BMPs, but again because funding is a severe constraint, such monitoring should be limited to evaluating new technologies or uncertain applications of those technologies.

The goals and objectives of the Monitoring Management Action, Status and Trends Action Plan remain focused on gathering information necessary to evaluate the effectiveness of management action recommendations specified by the CCMP, both individually, and cumulatively. The mechanisms to evaluate the outcome of each action plan recommendation are already specified throughout this document under the "measuring success" heading under each action plan recommenda-

tion. The recommendations in this Monitoring Management Action, Status and Trends Action Plan focus on mechanisms to support those more specific recommendations, as well as more broader actions to implement successful efforts to monitor the environment and communicate those findings.

Data Availability and Reporting Results

To be meaningful to scientists, managers and the public, monitoring data must be made readily available both in its raw form, and in more synthesized forms that can be understood by the lay public. This increased availability makes the action of government more accessible and transparent to the public.

On the other hand, efforts involving online relational databases merging disparate databases have not proven widely useful, and can be expensive to maintain. Rather, data should be made available in its native or original format (spreadsheets, GIS shapefiles, etc), for use by scientists and analysts to import into their own software or statistical programs. Data analysis and synthesis, which can be costly, should be reserved for specific programs.

To communicate other aspects of tracking CCMP progress and outcomes, the Buzzards Bay NEP established a Status and Trends web page (<http://www.buzzardsbay.org/trends.htm>) that includes a variety of water quality, living resource, and management tracking parameters. The Buzzards Bay Coalition created a complimentary State of the Bay page on their website¹¹⁸. Both programs collaborate when evaluating data sets to ensure the data and information presented on these web pages are consistent. The Buzzards Bay NEP also continues to track and post information on CCMP implementation projects with links and information on their outcomes.

Other state and federal agencies are making individual data sets available online. Some websites, like the Massachusetts Department of Public Health beach monitoring results website¹¹⁹ are very popular with the public and the increased transparency and availability of the data in some cases has focused municipal efforts to address pollution problems or issue precautionary rainfall advisories.

Research Needs

While the monitoring efforts described in this section will be used to track progress in meeting the goals and objectives of this CCMP, there is an ongoing need for research to study the many uncertainties and unanswered questions that remain in our understanding about

the threats facing Buzzards Bay. Some important research questions include:

What are the impacts of pharmaceuticals and other emerging contaminants?

What are the synergistic or additive effects of pollutants and other stressors?

How will shifts in precipitation, water temperatures, and ocean acidification caused by green house gas emissions alter coastal ecosystem structure and function?

What are the human health threats of low level contaminants in seafood?

How are invasive species alter coastal and inland ecosystem?

Management Approaches

In the face of environmental program budgets, more than ever, tracking environmental progress will be met through cost effective strategies of monitoring indicator species like herring abundance using field counters, or through remote sensing for eelgrass and wetland coverage. Tracking of water quality stressors like nitrogen in receiving waters by the Coalition's citizen water quality testing program must continue, and this program must be expanded to incorporate nitrogen TMDL sentinel stations.

Tracking of programmatic reporting is essential, and will be used to evaluate land protection, water withdrawals and water conservation measures, and shellfish bed closures to name a few examples. Because of the self-reporting required under various state and federal permit programs, it is essential that regulators require well reasoned monitoring requirements, and make this data readily available for analysis.

Financial Solutions

Monitoring programmatic actions have modest costs. The cost of field monitoring described in the various action plans in the CCMP may total hundreds of thousands of dollars annually. Some monitoring needs can be met through new permit requirements, research grants may assist in evaluating contaminants of emerging concern, or federal watershed assessment grants (604b), but most monitoring costs must be borne by agencies managing the environment.

Monitoring Progress

This action plan is primarily concerned with ensuring sufficient data and information is collected to evaluate progress on all the other action plans. The success of this action plan will be defined by whether the information is readily available and communicated to ensure that agencies and the public can evaluate the success of the CCMP. In this respect, the status and trends webpages on the BBNEP and Buzzards Bay Coalition, and

¹¹⁸ <http://www.savebuzzardsbay.org/Document.Doc?id=11> last accessed 11/20/2009

¹¹⁹ http://mass.digitalhealthdepartment.com/public_21/index.cfm last accessed 11/20/2009

The Buzzards Bay Citizen Monitoring Program: A Buzzards Bay Success Story

One of the hallmarks of monitoring in Buzzards Bay has been The Buzzards Bay citizen-based water quality monitoring program, which was initially jointly implemented by the Buzzards Bay Coalition (then called the Buzzards Bay Coalition) and Buzzards Bay National Estuary Program in the spring of 1992. The program was designed by Dr. Joe Costa and Dr. Brian Howes to address the need to monitor and evaluate nitrogen impacts to coastal waters as outlined in the Buzzards Bay Comprehensive Conservation and Management Plan. The Coalition organizes and trains the citizen volunteers and coordinates data collection and entry.

The citizen's program measures dissolved oxygen concentrations with Hach Kits™, secchi depth, salinity, and temperature approximately 15 times between June 1 and September 30. The citizens also collect 2-4 water samples during summer, which are analyzed for dissolved, and particulate organic nitrogen, nitrate + nitrite, ammonia, orthophosphate, and chlorophyll. Generally, the program monitors 2 to 4 sites within each embayment. In some smaller embayments only one site is monitored; in larger embayments 5 or more sites were sampled. The volunteers take samples for nutrient analyses during outgoing tides, while oxygen and secchi data included both incoming and outgoing tides because the oxygen measurements are needed in the early morning hours, generally taken between 6-9 AM, as indicated by Taylor and Howes, (1994).

One key innovation of the program was its attempt to combine a basket of indicators into a single Eutrophication Index. The Buzzards Bay Eutrophication Index was created by Dr. Joe Costa in 1992 as a tool to present a simplified summary of the Citizen's monitoring program data (read the first Baywatchers Report, issued December 1992). The Index was modeled after a water quality index adopted by Hillsborough County in Florida to evaluate changes in Tampa Bay water quality. This water quality index approach was based on defining, for each water quality parameter used, a "poor" water quality value (0 points), and an "excellent" water quality value (100 points). The adoption of the 0 and 100-point values was made after consultation with Dr. Brian Howes, who had set up the monitoring program with Dr. Costa. The values are log transformed in the formula for calculating the index because of the log-normal ecosystem response to nitrogen loading. More details on the methodology are provided on our Eutrophication Index page.

In the first 4 years of the program, the Buzzards Bay NEP funded the startup of the program and provided nearly all the funds necessary to operate the program, which included funds to the Buzzards Bay Coalition for a monitoring program coordinator and funds to a research laboratory to provide for water quality analyses. Since 1996, the program has been managed exclusively by the Buzzards Bay Coalition and UMass Dartmouth. In the mid-1990s, the Buzzards Bay NEP suspended funding to the water quality monitoring program due to federal cutbacks. During that time, the Coalition continued the program with grants and donations. They also received roughly \$10,000 annually from Buzzards Bay municipalities. In later years, the Coalition was able to secure state funding through an earmark of the state legislature of \$50,000 to \$150,000, which now pays for a large portion of monitoring costs, and enabled the Coalition to expand nutrient testing further upstream some estuaries. Today, the Buzzards Bay National Estuary Program continues to provide between \$20,000 and \$30,000 annually to support the program. Through the years, the Coalition has continued to fund unmet needs through donations and fund raising.

In 2001, Massachusetts DEP began using the data from this program to develop nitrogen TMDLs in the Massachusetts Estuaries Project and this effort is continuing today. The Buzzards Bay NEP remains a strong advocate for this effort, and is using these data evaluate the success of efforts to protect and restore Buzzards Bay.

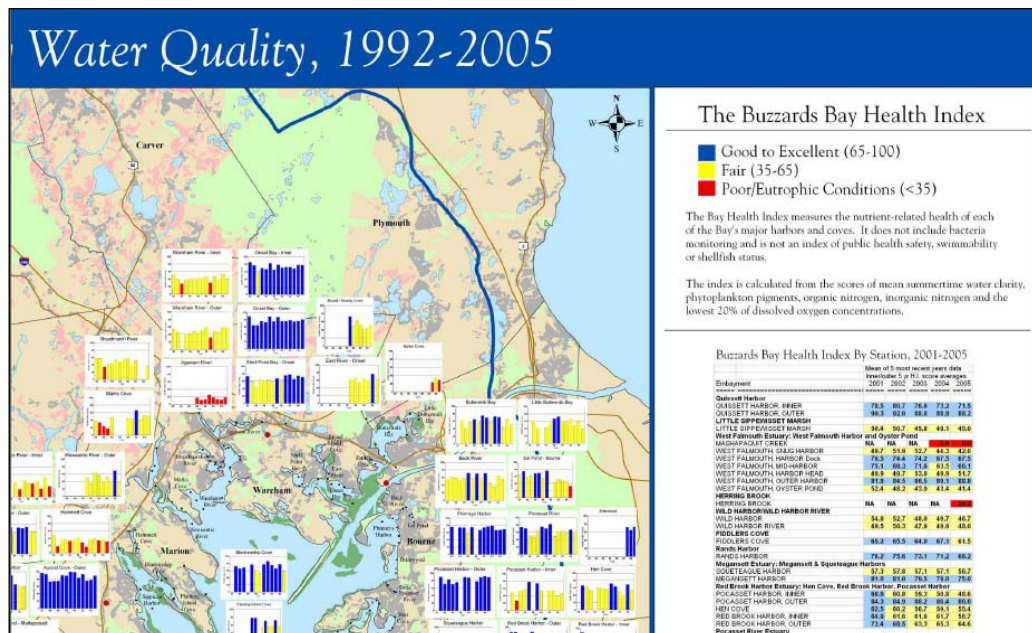


Figure 101. Portion of a poster prepared by the Buzzards Bay NEP for the Buzzards Bay Coalition, showing 13 years of water quality results collected through the citizen monitoring program.

related outreach documents clearly and concisely com-

unicate this information.