Lesson Learned from Coordinated Monitoring Programs

Many programs are conducted throughout the United States to monitor coastal ecosystems. They address a variety needs and goals, and range from issue-specific to highly complex, interdisciplinary programs that focus across a spectrum of human interactions with the ecosystem. In many cases, the programs are conducted independently from other programs. However, others strive to coordinate and integrate monitoring efforts across several agencies, states, NGO's, or countries. These programs have faced many of the issues and questions raised during the planning of the Atlantic Northeast Costal Monitoring Summit. Thus, they provide fertile ground from which information can be gleaned relative to, implementation and management, and lessons learned for avoiding or overcoming constraints and barriers that limit the effectiveness of the programs.

To assist the Atlantic Northeast Costal Monitoring Summit, six of the more complex and successful monitoring programs were contacted and questioned about the lessons that they have learned from their experiences. The six groups contacted were:

- Chesapeake Bay
- Great Lakes Program
- Gulf of Maine – Gulf Watch Program
- Massachusetts Water Resources Authority
- National Coastal Assessment
- Southern California Coastal Water Environmental Resources Program

In most cases, the information obtained were similar to those characterized in the National Research Council's 1992 seminal book on monitoring coastal systems *Managing Troubled Waters* (see text box located at the end of this paper). For ease of presentation, the information from the interviews are summarized by the key steps identified in *Managing Troubled Waters* for developing an effective monitoring program:

1. Planning and products
2. What, When, Where, and How
3. Data management and Reporting Results
4. Program Review
5. Funding
6. Communication and Coordination

Planning and Products

The individuals interviewed clearly linked program success to early identification and articulation of the program goals, objectives, and products. A major universal theme was to obtain agreement (buy-in) on a detailed purpose for conducting a coordinated effort (a common ground) by all stakeholders. Interviewees cautioned that simply saying coordination needs to occur was not sufficient; rather it was believed

> In all cases [of successful monitoring], monitoring provided clear and important input to management decisions, and it was targeted at issues that the public and decision makers recognized as important.
>
> *Managing Troubled Waters*

imperative that each stakeholder feel that their efforts will help to achieve a goal.

A second major and universal theme voiced by the interviewees was the importance of developing a plan that can be implemented. Some programs recommended adopting the principle of adaptive management that calls for reassessing program needs and adjusting the program accordingly. These programs recognize that needs change over time as additional issues arise from monitoring results and information. These programs also recognized that the monitoring questions, hypotheses, and measurements may need modification as the program grows and matures. Thus, the third theme conveyed by the interviewees was to build-in flexibility that can be systematically addressed into the program. The last theme lesson conveyed under this category was to develop achievable plans. Starting with a smaller project (or pilot project) that can be successful was felt to be a better option than beginning a large program that never meets its goals.

Several specific examples provided by the programs include:

- Identify the management questions the program will answer
    - Make sure the management questions are clear
    - Address issues of interest to managers
    - Be detailed in the beginning, not later
    - Identify the relevance of the program to the public and ecosystem
- Identify the scientific questions (hypotheses) of primary focus
    - Make hypotheses ecosystem based rather than focused on a narrower view. (Defining these is important because they will ultimately be used to guide the monitoring design and focus)
    - Do not make hypotheses and monitoring solely politically driven. There should be a scientific or socioeconomic reason for conducting the monitoring. (Avoid monitoring just because someone wants to know).
    - Required those requesting monitoring to assist and provide feedback.
- Define products and always work towards completing the product.

What, When, Where, and How

What Monitoring should be conducted?

A common theme voiced from the programs interviewed was the importance of identifying a set of core (key) indicators that are measured throughout the ecosystem. For effectiveness, each indicator should have a clear use that is related to the purpose and objectives of the program. Experience indicated that measurements taken without a clear use detracts from the focus of the program. This theme was also tied to funding which is an issue that must be considered. Having clear links between budget and commitments to develop tangible measures was identified as very important.

> Don't wait for the system in which you are working to be perfectly modeled or understood by the scientists or experts. Data gaps and analytical problems will always exist, and insistence on using best available information will inspire improvement over time.
>
> *Environmental Outcome-Based Management: Using Environmental Goals and Measures in the Chesapeake Bay Program*

The advice from those interviewed included basing key indicators on those parameters that will help measure the overall status of the ecosystem through the collection of a long-term data set. The ability to compare long-term data sets with similar data sets developed by other programs was clearly articulated. Maintaining the ability to identify additional indicators to supplement or replace existing indicators when new issues emerge was considered important. Also important was having sentinel indicators.

The following additional suggestions were made:

- Monitor for changes in non-harmful items along with harmful items.
- Baseline characterization is always helpful if available.
- Avoid choosing indicators based solely on their familiarity, ease of measurement, and low cost. Make sure they relate to the monitoring questions and hypotheses.
- A monitoring program inventory is imperative to determine what is already being monitored and where.

When and Where Should the Monitoring be Conducted?

Interviewees communicated similar lessons relevant to these questions, which follow below.

> Work hard to reach consensus among the key stakeholders on the selection of appropriate measures, interpretation of data and use. Once sold on the value of the measure they will help maintain it over time.
>
> *Environmental Outcome-Based Management: Using Environmental Goals and Measures in the Chesapeake Bay Program*

- Key indicators should have minimum spatial and temporal requirements defined. Use of probability-based sampling design was suggested as a means of tailoring the monitoring design to each state's sampling program, but keep the statistical validity of the program intact.

- Collection of information on factors exerting external influence to a system (i.e., regional to global scale) to ensure the cause and extent of any trend is correctly interpreted (*i.e.*, local influences vs. distant influences like air deposition effects).

How Should the Monitoring be Conducted?

Sample collection and analysis brought the largest variety of answers from those interviewed. Two approaches to ensure comparability among programs were 1) standardized protocols and use of specific analytical laboratories or both to perform all of the program's work and 2) having various laboratories and agencies perform the work as long as they participated successfully in interlaboratory calibration exercises (performance based measurement programs).

Reasons for using one or the other approach were varied. Those that use standardized protocols or specific analytical laboratories felt that this was the preferred method to assure data comparability over the programs life. Groups using several different laboratories found that in many instances, the use of in-kind services from state agencies resulted in a higher chance of the measurements being continued over a longer period of time. Others indicated that jurisdictional and institutional boundaries have been found to reduce the comparability of data and impede information transfer.

An important theme was the importance of identifying data quality objectives and uniform levels of quality assurance. One group noted, "*Bad data is worse than no data.*" A related lesson was that failure to clearly define and use data quality objectives from the beginning, made it impossible to know whether trends in the data were real or a result of data quality problems.

Reporting Results

Reporting monitoring results in a timely and public friendly manner was conveyed as very important for keeping the public's interest in a program. Others indicted that an effective data and data products dissemination strategy that is useful to decision makers can help obtain continued cooperation of involved parties and show the need for continued funding of the work. In all cases, programs noted that information sharing and an information feedback system were important components of their program.

The interviewees were split on the use of centralized and distributed databases. Some rely on central database to ensure that all data are kept in one location for easy access. Others have relied on links via websites to access the data. Each system has its advantages and disadvantages. Some felt that central databases ensure that all data are located in one place and can be accessed through one system. Some felt that ensuring quality assurance was easier and more consistent with a central database. This was also found to be convenient for long-term temporal data comparisons. In addition, the advent of web accessible databases now enables easy access to the central database, allowing all participants direct access to the data for both data interpretations and observing how a program is progressing. Disadvantages voiced regarding a centralized database were the need to assign responsibility for maintaining the system and incurring holding and maintenance costs for the database. Some felt the capacity of the central databases can limit the inclusion of data from other monitoring programs.

Those programs using distributed database noted that with these systems, the costs of data management were shared throughout the group. This allowed each program to handle the data in the easiest way for them. It was indicated that this approach can make data comparison difficult, although web pages have been developed that collected the data from various locations through links. A strong commitment by all parties involved is needed to ensure data quality is maintained. A major drawback identified was the possibility that the work will not be completed by the various groups in a timely fashion.

Another lesson conveyed is importance of timely data interpretation into a product that is useful to decision makers. Truly effective systems for communicating findings of monitoring programs to the public, the scientific community, or policy makers in terms that the respective audiences

can understand were indicated as being extremely important to programs. Interviewees felt that for success, each program must develop reports that people really read and not just pass over. *Managing Troubled Waters* noted ten years ago that for most programs, too little attention and resources are directed at the management, analysis, synthesis, and interpretation of data relative to the investment made to collect the data.

> Share the environmental outcome information with the public and partners on a regular basis. This will often yield greater understanding of your efforts and help create the necessary public and political support for goal-setting and necessary environmental improvements.
>
> *Environmental Outcome-Based Management: Using Environmental Goals and Measures in the Chesapeake Bay Program*

Program Review

Also conveyed was the need for flexibility in the program design so that it can be improved as it matures. This included the flexibility to drop indicators found to be ineffective in addressing program goals, and adding measurements or indicators when necessary to address important emerging issues. Every program that has been running for several years noted that a periodic program review was very helpful in ensuring the program continued to operate in an efficient manner, both for the goal perspective and the conduct of the monitoring program. Most of the programs noted that the reviews were most successful when conducted by an outside group. A five-year review cycle was suggested for maximum efficiency.

Coordinating Efforts

The programs interviewed indicated that coordination of monitoring efforts requires a great deal of patience and energy to be successful. They indicated that coordination and cooperation is easier when common goals are identified and implementation is written into existing agency mandates. The importance of having leaders who push for development and use of the program was emphasized. Persistence and patience and a long-term vision for the program were identified as central to the success of the programs.

> "Human, technical, institutional, and financial limitations will always adversely affect any large regional enterprise."
>
> *Managing Troubled Waters*

The two key items for maintaining full cooperation and participation are:

- Communication
- Funding

Communication

Clear and open communication was noted as the most important item for a program's success. Lack of communication frequently results in a loss of momentum and enthusiasm to proceed. The following lessons were provided as ways to improve communication among program participants:

- Cooperative agreement vehicles, which specify what each group will supply, are important to develop from the very beginning.
- Meetings between agencies within each state and the entire program are essential.

    - Small meetings held more frequently within each state were found necessary to ensure the monitoring is conducted on time.
    - At least one meeting of the entire program should be held annually.
- Develop a Coordination Network Diagram
- Include analytical labs on the coordination team
- Develop a state/federal/academic monitoring committee to provide guidance to the program at a state/local level

Funding

The lack of sufficient funding was consistently conveyed by all programs. Most programs indicated a struggle to balance available funds against the programs needs and requirements. Suggestions were made that a program should start out as a pilot project then grow as it becomes more successful. It is sometimes easier to expand an already present successful program to include more parameters than trying to develop a completely new program.

In some cases, it was noted that programs were more successful when funds were expended to hire a program manager to focus on the program. In spite of the cost, it was advised that having at least one person focused on the goals of the project, assisted greatly in moving towards success.

Ten Steps to Strengthening the Role of Monitoring in Environmental Management

1. Clear guidance is necessary on how data are to be used and what type of decisions are to be made.
2. The goals established should be achievable scientifically, technologically, logistically, and financially.
3. The monitoring program should be integrated into the decision-making system, with decision points and feedback loops clearly established before the data are collected.
4. Where authority and control reside should be made explicit. Fiscal controls should be compatible with program controls and objectives.
5. Channels of communication among agencies and other participating individuals and groups should be identified and efforts made to ensure that the channels are interconnected and functional.
6. The monitoring program should integrate the regulatory, data, and management needs and responsibilities of the local, state, regional, and federal agencies to optimize the use of available resources.
7. Viable mechanisms should be established to involve the public and the scientific community as program participants early and often.
8. The monitoring program should include built-in mechanisms to ensure that its conclusions are communicated to decision makers and the public in terms that they can understand and act upon.
9. Monitoring programs should include mechanisms for periodic review and easy alteration or redirection of efforts when monitoring results or new information from other sources justifies a change.
10. The management action to be taken in response to both the expected results and unexpected but possible outcomes should be identified in advance.

Managing Troubled Waters

References

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