Monitoring: Some perspectives for success

David Wilford

Throughout the province we are hearing the call to monitor the effects of restoration projects in watersheds. Land-use planning and plans for community and fisheries-sensitive watersheds all require monitoring for effective implementation.

Monitoring is a motherhood term that people tend to use without fully considering its meaning. At first glance, the concept of monitoring seems easy to understand, and asking someone to track the effects of forestry or restoration activities a reasonable request. Yet, experience shows that monitoring is not simple; many monitoring projects fail to provide useful information and, if not carried out properly, can waste time and funds while harming credibility.

The objective of this paper is to present key concepts required for successful monitoring. No matter what you may need to measure, these concepts are fundamental to the monitoring process.

A working definition of monitoring is "to describe a variable or variables and track changes over a period of time" (MacDonald et al. 1991). "Variable" can refer to site or watershed level factors (e.g., surface erosion of a cutbank or water quality at the mouth of a stream). Selecting appropriate variables at the outset is a fundamental decision in a monitoring project.

Selection of Variables

Most elements of a watershed are interconnected, so those who make management interpretations based on monitoring results must be careful to avoid treating a process in isolation, or making assumptions about linkages. For example, natural sediment production in a watershed is generally related to precipitation and snowmelt events, so while forestry practices may increase sediment production, precipitation will still be a key factor. For example, a project examining sediment accumulation in lakes determined that sediment production in several watersheds was higher in the pre-logging period than during or after logging (Beak 2000). Based solely on the monitoring results, should we have concluded that logging reduced sediment production? On the contrary, this somewhat surprising result turned out to be directly related to precipitation: the logging/post-logging period was drier than the pre-logging period. Examples such as this show that it is essential to analyze the results in context, in this case, the context of precipitation cycles.

Thus, watershed managers should address several questions before selecting variables:

- Do you expect the variable to change as a result of forestry activities?
- Do you have a technical basis for this expectation?
- How similar is the watershed in question to the watersheds reported in the literature?
- What degree of sampling will you require to detect a change (e.g., sample size and sampling frequency)?
- How will your team measure the variable and what are the limitations to the sampling technique?
- What associated variables could cause an influence and how will your team measure these influences?

Establishing a Baseline

A common perception is that natural watersheds never have dirty water. Hence, when those involved in a water-quality monitoring project describe the current water quality, sediment sources, and channel conditions, they will find the exercise an enlightening one. It may take many years to establish a baseline (e.g., ten years for paired watershed studies), but this process provides insight into natural variability (e.g., describes the range or population of a variable). During this period, there will be a reasonable amount of climatic variation in the watersheds, including some extremes. Without some understanding of such extremes, monitoring personnel will need to interpret post-treatment responses subjectively and the monitoring project may be of limited use. It is critical to know the natural or background level of the measured variables before human activities begin in a watershed: water quality is a case in point.

Monitoring Methods

While there are many variables and a broad spectrum of instruments to use, monitoring can also proceed with no measurements (e.g., descriptive assessments). Analysis of results can be quantitative or qualitative. You

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may apply results directly to forest management, or file them into archives for future reference (i.e., when the team identifies no impacts). The objectives of a monitoring project must relate directly to the methods the project will employ.

Steps in Monitoring

Step 1. Define objectives

The task of defining objectives is an important step for your project and is not one to rush through. When you clearly outline reasons and objectives for the monitoring project, you will ensure that all participants (from public groups to managers) know what they need to accomplish. Information exchange is a key aspect of developing objectives. Participants should sign off on the objectives to show they understand and support the scope of the project. The objectives will direct the project.

A problem analysis outlines an issue, refers to the literature to define state-of-the-art knowledge, identifies any unknowns or obstacles, and proposes relevant approaches. Your problem analysis should include details of how and when to take measurements, as well as a review of the different types of instruments, their levels of precision, field utility, and costs. The problem analysis is part of the information exchange for those people who require the monitoring. It also helps establish a network of technical resource people. Writing a problem analysis may require a significant effort on your part, but it will ensure that the project is on the right track and that your time will therefore be well spent (Anon. 1995).

If your project lasts longer than a month, chances are that new people will get involved after the process is already underway; these new arrivals may have questions, too. A thorough paper trail will help you explain how and why you determined the project's objectives.

Seven Types of Monitoring
(Adapted from MacDonald et al. 1991):

TREND: Measurements at regular intervals to determine the long-term trend in a particular variable.

BASELINE: Description of conditions to establish baseline data for planning or future comparisons.

IMPLEMENTATION: Assessment of activities to determine whether they were carried out according to plans. (Generally this entails few, if any, measurements. An example would be determining whether riparian-zone widths comply with the Forest Practices Code).

EFFECTIVENESS: Evaluation of the degree to which a specified prescription had the desired effect (for example, determining whether a riparian zone maintained water temperatures during mid-summer).

PROJECT: Assessment of the impact of a particular project on a given variable (for example, the impact of road construction and/or harvesting of a cutblock on water quality, involving upstream/downstream data collection).

VALIDATION: Quantitative evaluation of a model designed to predict a particular variable. The monitoring data would be used to test the model.

COMPLIANCE: Determination of the extent to which specified variables are within appropriate limits, usually in relation to government regulations (for example, fecal coliform in community watersheds).

There are at least two types of monitoring that are not considered legitimate:

ESTABLISHING A PRESENCE: The presence of personnel on-site for the sake of appearances (that is, management is not interested in what is done as long as "scientists are seen out there with sampling equipment").

MOTHERHOOD MONITORING: Monitoring only because "it's the right thing to do" (that is, the collection of data with no plan for analysis or reporting).

Step 2. Develop a Plan

Refine details from the problem analysis by preparing a working plan that covers how you will monitor the variables, what your sampling frequency will be, your sampling locations, and the analytic procedures (Anon. 1995). At this point the concept of monitoring becomes a reality: during this process you will determine the exact details of the project. There is much to learn in this step, and it is essential that you develop a network of contacts. The working plan provides a clear picture of the project and will specify the nature and frequency of reports (including field presentations).

Step 3. Define Personnel and Budgetary Constraints

Once the scope of your project is clear, determine whether you have sufficient resources to undertake it by asking the question, "Can I run a monitoring project that will address these objectives?" Your answer should include a review of your current workload, present level of support, and anticipate the monitoring workload. Monitoring can take a lot of time, and it entails more than just fieldwork. Is it possible that other

pressures or issues may arise that will divert resources? If the resources are not available, go back to Step 2 and see where you can cut corners without cutting quality. If it is apparent that quality will suffer, do not start the monitoring project according to the original objectives. Instead, redefine the objectives with the original group. This is a stocktaking measure and it is essential to be realistic. If the project is planned for a certain area, what are the chances that a similar project will be requested in another area next month? Choose monitoring projects that will give a good return on investment, beyond the specific watershed.

Pay particular attention to matters such as employee availability and overtime procedures. If a project requires data collection on weekends or after regular working hours, will your personnel be available to accomplish this? Are there contractual roadblocks, such as limits to overtime? Who gives approval for overtime? Can you get approval? More than one monitoring project has been compromised because sampling could not be undertaken during non-work hours or during holiday weekends (R. Winkler, pers. comm. 2000).

Step 4. Pilot Monitoring Project

If your review indicates that resources are available, you will be ready to initiate the project on a pilot basis. This will give a quick picture of the challenges, and also provide some real data (though you may work with either real or hypothetical data before setting up equipment in the field). This will also allow you to become familiar with your equipment and with the process of data handling and analysis. Present results to the people requesting the monitoring to ensure they are satisfied that the work is on track to achieve their objectives. This step fine-tunes the project—you may have to return to previous steps if there are significant changes.

Step 5. Full Implementation of Monitoring Project

Monitoring can, but does not always, involve data collection. You must constantly review the data for accuracy and gaps. Storing the data is critical; too many monitoring projects focus only on the field component. Once the "monitors" return to their offices, there are many demands on their time, and data management can very easily take a back seat. Both data and field notes are key to a monitoring project. Field notes should include photos, slides, and video footage. The importance of film cannot be underestimated. It is essential for interpreting the data and for demonstration purposes. Do not be surprised if the people who requested the monitoring find the film more convincing than the data. With respect to presentations, plan for a dry run with management staff from your organization, as this will prevent some unwelcome surprises. Staff will also provide feedback to ensure an effective presentation. Plan field trips to show results, and ensure that staff complete and submit all reports according to the working plan.

Step 6. Implement Results

Monitoring is not an end in itself. Results should lead, where appropriate, to changes in operational procedures, practices, and policy, as well as the development of effective extension. You may need to develop and deliver training sessions. This is a time-consuming but important part of the process, as this work will make sure that the investment in monitoring will result in needed changes.

The reports may recommend changes to some aspects of the monitoring project itself. Make sure these changes support the original objectives, or that the group supports a change in the objectives. Consider writing an article for your local newspaper or a technical journal.

Take care to organize field trips well, with sites close together to illustrate the main findings. Successful field trips usually include refreshments, especially if the weather is cold and wet. Collaborate with other organizations where possible to maximize the reach of your findings and their implications.

Conclusions

Monitoring can and should be an integral component of watershed management. However, before you initiate a monitoring program, it is critical to invest in adequate planning and collaboration. Applying the series of basic concepts outlined above can assist you and your staff in the development and delivery of effective monitoring programs.

For further information contact:

David Wilford, R.P.F., P.Geo.
Research Forest Hydrologist,
Ministry of Forests
Northern Interior Forest Region
Smithers, B.C. V0J 2N0
Tel: 250-847-7428
E-mail: Dave.Wilford@gems3.gov.bc.ca

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