

Using Stream Geomorphic Characteristics as a Long-term Monitoring Tool to Assess Watershed Function

A Workshop

Co-Sponsored by

**Fish, Farm, Forests, and Farms Communities Forum; Simpson Timber
Company; National Marine Fisheries Service; Environmental Protection
Agency; Forest Science Project; and the Americorp Watershed Stewards
Program.**

**Humboldt State University, Founder's Hall, Room 118
March 18 & 19, 1999**

Proceedings edited by

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Final Draft: July 2, 1999

A Brief Overview of Channel Monitoring in Land Management: Five Case Studies

Case Study #1: Presented by Leslie Reid, USFS, Redwood Sciences Laboratory

Yesterday we heard about some successful monitoring programs, but today I would like to share some findings from a study I did, which was basically a post-mortem of failed monitoring programs. There were about 30 projects, and I wanted to know why did they fail, and were there patterns of why they failed. The projects ranged from university studies, land management, and research. Costs ranged from \$10,000 to \$100,000.

Problems fell into two general categories:

1. Project design: problems that occurred prior to implementation, occurred in about 70% of the programs investigated.
2. Procedure: problems that occurred only during implementation, occurred in about 50% of the programs investigated.

Most of the programs had multiple problems, often in both the design and implementation phases.

Problems Identification:

1. Procedural: 37% of the projects, field staff was less than ideal. Possibly from inadequate training, education or motivation to follow procedure and accurately collect the required data. Lack of involvement by principle investigator to ensure collection of quality data.
2. Design: about 30% of the projects, monitoring methods used couldn't measure the variable of interest and answer the questions that the study was supposed to address. Example: a project to monitor the effects of suspended sediment from a logging road positioned samplers in locations that failed to detect the suspended sediment contribution of the road in the mainstem river channel.
3. Procedural: 27% of the projects, data analyzed too late to address the problem. Start working up and examining the data immediately and it may save future problems, such as the continuation of an incorrect field procedure. Example: a project where the data was not examined for 14 years from a project where a settling basin was used to catch sediment. What was the sediment yield from these basins? Unfortunately, the catches were surveyed after the sediment was dug out, so that every year the empty catch was surveyed – no change. The amount of sediment was never quantified. If the data had been examined after the second year, the procedural error may have been caught and corrected.
4. Design: 27% of the projects, study period was too short to detect changes or responses (especially if weather driven). Example: any five-year study during the recent (late 1980s)

California drought would not have shown much response to hydrologic events. Relates back to lag time between hillslope activity and channel response.

In defense of turbidity sampling, this parameter does have a quick response time and is probably one of the better “real-time” monitoring variables we have available. Turbidity monitoring is important especially if you are interested in the effects of what is currently happening upslope. For example, in Humboldt Bay, a local watershed group monitored suspended sediment by sampling 11 days over two months at 14 locations (seven control locations and seven with varying degrees of landuse). Results: the turbidity rating curve was highly correlated to intensity of logging and road density upslope. Was in violation of the basin plan. About a 500% increase in turbidity in heavily managed watersheds.

5. Procedural: 20% of the projects, collateral information necessary to interpret results was missing. Example: using mixed units or no units at all for important measurements.
6. Procedural: 17% of the projects, the use of cryptic technology that fails when needed. For example, data files that are damaged, but are used because people assume they are correct. These data sets may be used extensively, providing mis-information for many years.
7. Design: 17% of the projects, inadequate problem analysis. Not enough evaluation of how to answer the questions regarding a specific problem or objective. Example: doomed reservoir, how long until the reservoir would fill with sediment was estimated by using the universal soil loss equation (only surface erosion) didn't consider landslide contribution (which was a dominant process) in the specific watershed. The reservoir had a calculated lifespan of 100 years, yet it filled in several years. If the planners had looked at aerial photos they would have recognized that landslides, not surface erosion, were the main sources of inchannel sediments and not have made the same calculation (or even selected a different dam location).
8. Design: 13% of the projects, basic misunderstanding of the processes, species, or parameters of interest. Example: population response lags, or need to understand the mechanism to interpret the results – there is a learning curve involved. The FFFC channel monitoring protocol may have to be implemented over long time periods before the links between landuse practices and channel responses are understood. Natural variation in channel form due to natural processes must also be teased-out over long time periods.

In many cases on the current landscape of the Pacific northwest, assessment may be a more effective tool than monitoring for evaluating the effects of landuse practices because the experiment has already occurred. Monitoring implies that management will also occur in the future; whereas assessment can examine the current condition of the landscape and the past management practices that have occurred in the watershed.

9. Design: 13% of the projects, weak statistical design. Example: same statistical power could have been achieved with one-third the sampling effort. Can also prove any change is insignificant with processes with large inherent variation.

10. Procedural: 13% of the projects, personnel changes. Example: large turn-over of field crew, especially in monitoring that occurs over many years. Quality of the field work may vary from year to year.
11. Procedural 10% of the projects, lack of long-term institutional support. Example: lack of funding for long-term (decades or more) monitoring programs.
12. Procedural: 7% of the projects, change in protocol. Best summed-up yesterday by Trent McDonald, "protocol drift is not allowed."

Channel monitoring programs are particularly susceptible to several of those problems. Identification of trends and changes in channel form usually requires long monitoring periods because:

1. major changes tend to occur during infrequent storms so that many years may pass before change is provoked, and
2. gravel moves relatively slowly along channels so there is usually a lag between a triggering event and a downstream response.

It is difficult to use channel monitoring results to associate downstream responses with upstream activities because of these lag times, and because many factors influence the downstream response. These influences must be well understood so that relevant collateral information can be collected to allow interpretation of the observed.

It is important to define the objectives of a monitoring study carefully so that a strategy can be devised that will be capable of meeting those objectives. If the study is intended to provide feedback for adaptive management, for example, monitoring results must be available quickly and must relate directly to the outcome of the practices being evaluated. Once objectives are defined, methods other than monitoring are often found to be capable of providing the necessary information more efficiently. In many cases, the relevant "experiments" have already been carried out, and questions can be answered quickly by observing existing conditions rather than by monitoring future conditions.

Common Traits of the Failed Projects

1. Parameters were selected because there was an established protocol (but maybe not right for the specific watershed or objectives) or the parameters were easy to measure. Thus the program was not designed primarily to answer the specific questions posed.
2. Study plan was not adequately reviewed prior to implementation. Almost all of the 30 reviewed projects lacked adequate review of the methods to answer specific questions, or for statistical rigor.

3. Didn't understand the mechanism of the monitored response. This occurred both on temporal and spatial scales. Some studies may have expected answers (measurable responses) in five years, but in reality may not occur for 20 or more years of channel monitoring.
4. Principal investigator was not present in the field. In many cases having the person who designed the monitoring strategy in the field assisting in the data collection, and observing firsthand what is happening may alleviate some of the other problems encountered later.
5. Data analysis started after the monitoring ended. If data are entered and examined as collected, many problems with sampling design, protocol, or equipment failures can be detected and corrected early in a monitoring project.
6. Cost and effort were underestimated. Many studies failed to budget costs of data entry, analysis, interpretation, and report writing. All you end up with is a huge stack of data sheets buried in a file cabinet.

Remedies to these problems? Don't do them!

Current Channel Monitoring Protocol:

What is it designed to answer? Which of these two questions would you hope it could eventually answer?

1. How can the existing Forest practice Rules be modified over a five-year period to better protect public trust resources (salmonids, downstream water quality, etc.); or
2. How will the morphology of reach "X" of channel "Y" change over the next 20 years?

Hopefully the protocol is designed to address the first question. This is the preferred type of question that channel monitoring should try to answer.

Implications for Channel Monitoring Protocol:

1. Credibility: currently that both industry and regulatory agencies are perceived as lacking credibility with one another. The development of a channel monitoring tool that could provide information and quicker response to modify (improve) hillslope practices is a marvelous opportunity to gain scientific credibility.
2. Expectation: is that the channel monitoring will eventually be able to better address hillslope management practices and protect downstream beneficial uses. If the channel monitoring can meet these expectations, it would also provide industry a credibility boost.
3. Adequate funding: the proposed channel monitoring protocol is very expensive, costing Simpson three-person weeks to complete just the data collection in a single reach. There has

to be a long-term funding commitment to eventually get the answers to the specific questions and objectives. Additional funds are needed for other studies so that the channel monitoring does not occur in isolation of other physical and biological processes.