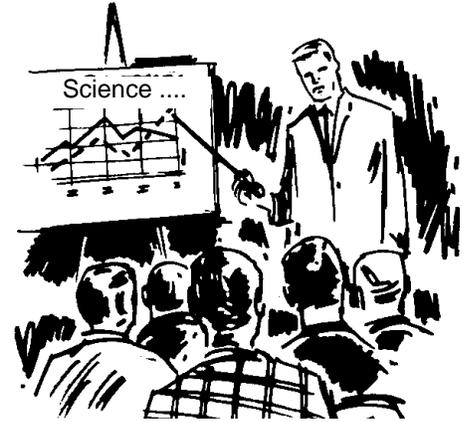


Science: Perspectives for Natural Resource Managers

Claudia E. Kelley



The Annual Society for Range Management meeting was held February 2000 in Boise, Idaho. This week-long event was comprised of presentations ranging from technical sessions on vegetation management and ecosystem restoration to a symposium on range management education in the 21st century. Of particular interest was the symposium "Science: Perspectives for Natural Resource Managers" which defined science, provided examples of the different contexts in which science is used, and evaluated appropriate and inappropriate uses of science.

The Western Coordinating Committee-40, a Land Grant University research committee, created this symposium as a forum to provide a perspective of science from research, management and public interest communities who are involved with modern, complex land use decisions. Following the symposium there was a general request from those attending, for publication of the presentations in their entirety. It was agreed that the Society for Range Management would publish the proceedings in *Rangelands* and the authors were given an opportunity to develop their presentations for publication.

The June issue of *Rangelands* contained the first paper in the series. The paper entitled "Junk or Science in the Court System: You May Be Surprised" was written by W. Alan Schroeder. In his paper, Schroeder discussed the different standards used by the court system to weigh evidence. He illustrated how the outcome may well depend upon the venue of the complaint since the venue determines the type of standard to be applied in reviewing the method employed by the land manager. He proposed that the ultimate gate keeper of junk or science in the field of range management, should not be the court system but instead the commitment to only apply methods to decision-making processes that conform to high standards. With the exception of the paper presented by Barbara Allen-Diaz and Kenneth W. Tate, entitled "Science, Dogma, or Fact: Grazing the Sierra Nevada", the other symposium papers are presented following this introduction.

Rangeland management developed as a discipline integrating the art of management with the use of science. However, in recent years, intense public input and laws requiring the use of science in the decision-making process, have required managers to have more support from scientific research in their decisions. With the pressure to provide scientific documentation to support decisions, managers need to find appropriate information that will allow them to operate from a scientific perspective using results from scientific research as a base of

reference. However, because scientists and managers have interchanged information from science and art for decades, the literature used by natural resource professionals includes a mix of scientific reports and knowledge derived from experience. The frequency with which this information has been interchanged and treated as if it had uniform applicability has made it nearly impossible to differentiate between scientific and experiential reports making it difficult to determine the actual use of science in land management, particularly in the natural resources field. While each type of knowledge is valuable, each also has a specific area of utility. Thus it is important to be able to distinguish between the types of knowledge. One of the consequences of this process is that public natural resource documents are often criticized for misusing science.

Contributing to the misapplication of science is the fact that not all professionals are operating from a common definition of science. Science has a wide array of definitions from a general understanding of nature and how nature operates to specific information gathered under rigorous and controlled experimental conditions. The definitions of science used by natural resource professionals, and even between disciplines within the scientific community, are often quite different. However, the benefits of bringing natural resource managers together with individuals from different scientific disciplines are immeasurable. Ultimately, this bringing together of new views and perspectives should lead to a more comprehensive understanding of systems and issues. But without an appropriate use of information and a common baseline to work from, it is not any wonder that controversy surrounds implementation of science in management.

The symposium was intended to clarify many of the issues involved in this controversy and to help professionals determine how they could effectively use science to support the art of management. It is the hope of the participants in the symposium that this is just the first step in directing attention to these issues and that a commonly accepted view of the appropriate use of science and art in rangeland management will evolve from future discourses. At a time when the general public's confidence in science and scientists in general, and the natural resources field in particular, is declining it is critical that the scientific community lead the way in ensuring the accuracy and quality of the work they produce.

In what follows a brief synopsis is provided for each of the papers. For additional information on "Science, Dogma, or Fact: Grazing the Sierra Nevada" contact authors Barbara

Allen-Diaz and Kenneth W. Tate who may be reached at the University of California campuses, Berkeley and Davis respectively.

◆ **Science, Myth, and the Management of Natural Resources** by Frederick D. Provenza.

This paper compares reductionist science that emphasizes parts with systems science that emphasizes wholes. Provenza suggests that both approaches are deeply interrelated, and that both are integral to solving current problems. Science can be used to seek innovative solutions to these problems. He points out that at its best, scientific method "is the study of the processes of nature, which involves a journey into the unknown, to discover the ongoing workings of nature." At the completion of each journey we are offered truth, but science is always silent on how to use that truth wisely.

◆ **Describing and Categorizing Natural Resources Literature** by William C. Krueger and Claudia E. Kelley.

Current literature citations do not clearly state if the references used are scientific or experiential reports, making it difficult to determine the use of science in management. Krueger and Kelley have developed a protocol to classify the literature, and a system of reporting the classifications, so it is clear if information is derived from scientific studies or professional resource knowledge. They suggest published reports should be classified and referenced as either professional resource knowledge or science. Science should be further classified as to whether it is experimental research, a documented case history or a scientific synthesis, according to established criteria.

◆ **From Equations to Understanding** by Linda Joyce.

The objective of science is to create understanding. Scientific research is the process of building that body of understanding and involves the development of theories to explain observations. Some of the problems associated with developing theories can be overcome through the use of models, which are expressions of theory. Joyce points out that they can be used to represent and simplify reality and are useful in "showing the relationships between objects of a theory, the causal interactions, and the states of the systems." The focus of this paper is the use of analytical models to generate understanding of complex issues in range science and management.

◆ **Science, Politics, and Land Management** by Jack Ward Thomas and James Burchfield.

The increase in intensity of debates concerning land use assessments and planning has resulted in an increasing demand for the application of "good science" in the process. While this new reliance on science may be true in principle, it is increasingly confused in application. Thomas and Burchfield believe the current situation is due to a lack of understanding by politicians and the public as to what scientists are and what science is. They conclude that several shortcomings "must be recognized and addressed before science and scientists can play as useful a role as possible in land-use planning and management processes."

◆ **Management of Rangeland Grazing-Determination of Stocking Rates: Introducing Reliability by Appropriate Applications of Scientific Sampling Principles** by Michael A. Smith.

Determination of appropriate stocking rates is essential. The desire for improved resource conditions, more efficient grazing use and improved animal performance has driven the need for scientifically derived determinations of stocking levels. In this paper Smith describes the essential elements of using annual animal use indicators and trend in condition of the resource to manage stocking levels.

◆ **The Need for Science in the Range Livestock Industry: How Ranchers Evaluate and Use Science in Land Management** by Cassie Cady.

In recent years the U.S. Forest Service began using an ecosystems data gathering and management approach, called Ecodata, to make management decisions on the Lewis and Clark National Forest in Montana. Ecodata is a sampling method developed for analysis and classification of natural resources. This paper describes the implementation of the Ecodata methodology and asks readers to determine the validity of the science used in the process.

◆ **Perspectives: Science in Rangeland Management** by Clayton B. Marlow.

Marlow concludes the series with his perspective on the issues presented and a discussion on the role of science in the protection and management of natural resources.

Throughout the symposium two issues predominated. First, that the development of an objective and factual knowledge base is best achieved through the use of the scientific method. This process is enhanced when followed by a thorough review of pre-published manuscripts by qualified reviewers. Second, scientists, managers, policy makers, and the general public must constantly re-examine their knowledge base and landscape expectations, in response to the ongoing dynamics of natural systems. He suggested that "many of the conflicts over rangeland use may be the result of out-dated and unrealistic expectations of what rangelands can provide."

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