ARE WE IGNORING SCIENCE IN OUR QUEST FOR SIMPLICITY IN RANGE MANAGEMENT?

W. A. Laycock
Department of Rangeland Ecology and Watershed Management
University of Wyoming, Laramie, WY 82071 USA

ABSTRACT
Accurate determination of range condition and trend is essential for proper range management. In the United States, the range condition model currently used is not based on up-to-date ecological knowledge. It assumes a single stable state (climax) and linear pathways. Multiple stable state models more accurately depict community dynamics but have not been widely accepted. U.S. Federal land management agencies are using surrogates, such as qualitative "instant trend" measures and substitution of utilization for measured condition and trend to guide management. Most of these short cuts are not based on science. Attacks on livestock grazing by environmentalists are based on inaccurate assumptions about the effect of grazing on biodiversity.

KEYWORDS
Condition, Trend, Climax, Stable States, Threshold, Biodiversity, Utilization

INTRODUCTION
Worldwide, people are concerned that changes in rangeland condition and production caused by livestock grazing are occurring, soil is eroding, biodiversity is being lost, etc. Monitoring of condition and trend on rangelands determine whether such changes are taking place. Appropriate models are needed and the conceptual bases of these models used to determine condition must be ecologically sound or the models can yield erroneous information. In addition, the true effect of livestock grazing on biodiversity needs to be determined.

THE CONCEPT OF RANGE CONDITION
Managers need knowledge about range condition to know the current status of a given area of rangeland in relation to some standard. The Society for Range Management (Jacoby, 1989) defined range condition as "The present state of vegetation of a range site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions and amounts of plants in a plant community resemble that of the climax plant community for the site".

The basis for this definition is a "climax" (Friedel, 1991) or "successional" model (Westoby et al., 1989). Dyksterhuis (1949) first proposed the model, which is still used in the U.S. The concepts underlying this model relate directly to the climax and plant succession concepts of Clements (1916) and Sampson (1919) but are not based on current ecological knowledge. Westoby et al., (1989), Friedel (1991), Laycock (1991) and others have indicated that this model may not be valid for most arid and semi-arid rangeland vegetation types.

NEW STABLE STATE MODELS
The concepts of multiple relatively stable states of vegetation and thresholds are well known in ecology but are new to rangeland management. Friedel (1991) defined threshold as "a boundary in space and time between two states and the initial shift across the boundary is not reversible on a practical time scale without substantial intervention".

Westoby et al. (1989) introduced the state-and-transition model to identify multiple relatively stable states and the transitions between them. A state is a recognizable, relatively stable assemblage of species occupying a site. Forces that cause vegetation composition to depart from that recognizable state and move toward another state are called transitions. A state-and-transition model is an excellent way to organize information about how a system operates.

Most of the arid and semi-arid rangeland vegetation types in North America have more than one lower successional stable states (Laycock, 1991). When in one of these stable states, simple alteration or removal of grazing does not result in any substantial change in composition or range condition in a management time frame (years to decades) as predicted by the successional model.

An example of a simplified state-and-transition model is shown in Figure 1 for a sagebrush (*Artemisia*)/grass ecosystem in Western U.S. State I represents a "climax" stable state (Laycock, 1991). Transition 1 (T 1) represents long-term heavy grazing by herbivores which converts the community to State II (dense cover of sagebrush and depleted understory). Transition 3 represents fire or some other factor that kills mature sagebrush, converting the community to State III. If grazing pressure is reduced, the community may, over time, return to something similar to State I. States IV, V, and VI occur where climate is favorable for introduced annuals to replace the perennial understory.

Managers need to recognize communities in stable states where grazing (or lack of grazing) will not change the situation or improve condition. State-and-Transition models can help managers recognize stable state situations.

BIODIVERSITY
In the U. S., the environmental press claims that continued overgrazing on Federal rangelands has caused serious reductions of species diversity. Noss and Cooperrider (1994) stated: "livestock grazing has proven to be the most insidious and pervasive threat to biodiversity on rangelands". Widespread and prolonged heavy grazing by any herbivore *can* reduce biodiversity. However, claims that current grazing has detrimental effects on biodiversity ignore the following:

1) Plants are distributed in patches (Watt, 1947).
2) Moderate livestock grazing should increase patchiness and the variety of habitats at the landscape level.
3) Moderate grazing often leads to mid-seral conditions which favors a greater number of species (Clements, 1905).

OTHER CURRENT TRENDS AWAY FROM SCIENCE
Because of shortages of money and manpower, the Federal land management agencies in the U.S. are ignoring science and are using surrogates for range condition in their quest for "instant" answers. The Bureau of Land Management now uses non-quantitative checklists, rapid assessments, etc., none of which determine trend over time. The U.S. Forest Service uses similar methodologies.

An even more disturbing trend in both U.S. federal land management agencies is the use of only forage utilization, and not measured trend, to make range management decisions, especially stocking rate cuts. Almost all recent Environmental Impact Statements and Environmental Analyses from the U.S. Forest Service propose uniform utilization standards for entire National Forests. This also occurs in many Bureau of Land Management documents.

What is wrong with this? Valid research is seldom used to determine utilization standards. Also, the difficulty of accurately measuring utilization makes it a dangerous concept to use as the *sole* determinant for management or stocking rates (Sharp et al. 1995). Imposition of uniform utilization standards over large areas is not realistic. Meaningful utilization standards can only be set at the local level where they are tied to *measured* trend toward a land management objectives for a specific piece of land.

CONCLUSIONS

1. All range management practices should be based on up-to-date scientific information.
2. Range condition models must be ecologically sound and properly applied.
3. Surrogates for range condition, such as utilization, should not be used in place of trend over time to make management decisions such as stocking rate determinations.
4. The true effect of grazing on biodiversity needs to be determined.

REFERENCES

Clements, F.E. 1905. Research methods in ecology. Univ. of Nebraska Publishing Co, Lincoln, NE.

Clements, F.E. 1916. Plant succession. Carnegie Inst. Wash. Pub. 242.

Dyksterhuis, E.J. 1949. Condition and management of rangeland based on quantitative ecology. J. Range Manage. **2**: 104-115.

Friedel, M.H. 1991. Range condition assessment and the concept of thresholds. A viewpoint. J. Range Manage. **44**: 422-426.

Jacoby, P.W. 1989. A glossary of terms used in range management. Society for Range Management, Denver, CO.

Laycock, W.A. 1991. Stable states and thresholds of range condition on North American rangelands—a viewpoint. J. Range Manage. **44**: 427-433.

Noss, R.F. and A.Y. Cooperrider. 1994. Saving nature's legacy. Island Press, Washington D.C.

Sampson, A.W. 1919. Plant succession in relation to range management. U.S. Dept. Agric. Bull. 791.

Sharp, L., K. Sanders and N. Rimbey. 1994. Management decisions based on utilization—is it really management? Rangelands **16**: 38-40.

Watt, A.D. 1947. Pattern and process in the plant community. J. Ecol. **35**: 1-22.

Westoby, M., B. Walker, and I. Noy-Meir. 1989. Opportunistic management for rangelands not at equilibrium. J. Range Manage. **42**: 266-274.

Figure 1

Simplified state-and-transition model for a sagebrush-grass ecosystem in the Western United States (Laycock 1991). States (boxes) are recognizable, relatively stable assemblages of species occupying a site. Transitions (arrows) are forces that cause composition of vegetation to change, i.e., depart from a state and move toward another state.