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Brandon T. Bestelmeyer
U.S. Department of Agriculture

A. J. Tugel
U.S. Department of Agriculture

G. Peacock
U.S. Department of Agriculture

Daniel G. Robinett
Robinett Rangeland Resources L.L.C.

David D. Briske
Texas A&M University

See next page for additional authors

Presenter Information

Brandon T. Bestelmeyer, A. J. Tugel, G. Peacock, Daniel G. Robinett, David D. Briske, T. K. Stringham, P. L. Shaver, J. R. Brown, Jeffrey E. Herrick, H. Sanchez, and Kris M. Havstad

The regional ecology of alternative states and thresholds : strategies for ecological site descriptions

B . T . Bestelmeyer[1] , A .J . Tugel[2] , G . Peacock[3] , D . Robinett[4] , D .D . Briske[5] , T .K . Stringham[6] , P .L . Shaver[7] , J .R . Brown[2] , J .E . Herrick[1] , H . Sanchez[8] , and K .M . Havstad[1]
[1] USDA -ARS Jornada Range , Las Cruces , NM 88003-8003 , USA , E-mail :bbestelm@ nmsu .edu ; [2] USDA -NRCS , Las Cruces , NM 88003-8003 , USA ; [3] USDA -NRCS Central National Technology Support Center , Fort Worth , TX 76115 , [4] Robinett Rangeland Resources LLC , Tucson , AZ , 85719 , [5] Department of Ecosystem Science and Management , Texas A &M University , College Station TX 77843 , [6] Department of Rangeland Ecology and Management , Oregon State University , Corvallis Oregon 97331 , [7] USDA -NRCS West National Technology Support Center , Portland , OR , 97232 , [8] USDA -NRCS Central National Technology Support Center , P .O . Box 6567 , Fort Worth , TX 76115 .

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Introduction Land dynamics , ecosystem resilience , and the interaction of management decisions with them vary significantly across space . One-size-fits-all applications across distinct land types have been responsible for many failures in rangeland management . Ecological Site Descriptions (ESDs) and similar land unit classification systems specify the characteristics of different land areas associated with variation in rangeland potential , ecological dynamics , vulnerabilities , and monitoring needs . State-and-transition models (STMs) embedded within ESDs specify the plant community phases , alternative states , and characteristics of thresholds observed within particular land areas . In spite of considerable conceptual advances with regard to general STM structure and mechanisms , strategies for data-driven development of ESDs and STMs have been poorly developed .

Methods We use an empirical example from gravelly soils in central New Mexico , USA to outline a general approach to ESD and STM development that features 1) a hierarchical concept of rangelands and derivative inventory protocol that couples vegetation , climate , and soil sampling , 2) data collection at many points with varying levels of precision , 3) storage of data in a database to link soil , vegetation , and spatial location , and 4) statistical procedures and interpretations that emphasize how the occurrence of alternative states is related to soil and climate properties .

Results and discussion We found evidence to support the notion that the gravelly soils sampled comprise two distinct ecological sites (land units) featuring different vegetation dynamics . Low grassland resilience soils or soils featuring inherent dominance by shrubs occurred in soils with high carbonate content whereas high grassland resilience soils had low carbonate and high clay content . Restoration experiments were initiated to test our initial assumptions about grass recovery in these distinct land units .

Conclusions The linkage of region-scale inventory to expert knowledge and site-based mechanistic experiments and monitoring provides a powerful means for specifying management hypotheses and , ultimately , promoting resilience in rangelands . A major challenge is to systematize the linkage of multiple data sources in ESDs so that they can be evaluated and updated as new information emerges .