By Matt Germino

Browsing the Literature

For this edition of Browsing the Literature, we have a recommendation from Justin Derner and an array of papers published in the last 1 to 2 months that vary in being global and synthetic in scope (listed first) to studies focused on specific regions or sites (latter part of list). Please note that we are highlighting papers from non-SRM journals here and that this column is not exhaustive in covering rangeland literature.

Integrating spatio-temporal variation in resource availability and herbivore movements into rangeland management: RaMDry—An agent-based model on livestock feeding ecology in a dynamic, heterogeneous, semi-arid environment. Fust, P., and E. Schlecht. 2018. *Ecological Modelling* 369: 13–41. https://www.sciencedirect.com/science/article/pii/S0304380016304227/pdfft?md5=d719f7728c92d642ba8704ff07f56048&pid=1-s2.0-S0304380016304227-main.pdf.

Authors use an agent-based approach to develop a spatially explicit model that integrates movements and feeding behavior of ruminants to assess the potential of adaptive livestock production in highly dynamic, heterogeneous semiarid rangeland ecosystems. This article comes recommended by Dr. Justin Derner, Research Leader, USDA Agricultural Research Service, Cheyenne, WY.

Increasing importance of precipitation variability on global livestock grazing lands. Sloat, L.L., J.S. Gerber, L.H. Samberg, W.K. Smith, M. Herrero, L.G. Ferreira, C.M. Godde, and P.C. West. 2018. *Nature Climate Change* 8:214–218. https://www.nature.com/articles/s41558-018-0081-5.

Precipitation variability is a major challenge for rangeland management. This study evaluates the impact of changes in within- and between-year variability in precipitation, globally, on plant productivity (greenness) as estimated by the satellite-derived Normalized Difference Vegetation Index. Areas with a high coefficient of precipitation variability (CVP) had lower livestock-carrying capacity than less variable regions. Pastures had 25% greater interannual CVP than the average land area, and CVP is increasing over time. The authors highlight rangeland areas around the world that are particularly vulnerable.

Invited review: A position on the Global Livestock Environmental Assessment Model (GLEAM). MacLeod, M.J., T. Vellinga, C. Opio, A. Falcucci, G. Tempio, B. Henderson, H. Makkar. A. Mottet, T. Robinson, H. Steinfeld, and P.J. Gerber. 2018. *Animal* 12:383–397. https://www.cambridge.org/core/journals/animal/article/invited-review-a-position-on-the-global-livestock-environmental-assessment-model-gleam/7FA5D89A3A261F4BD08A3FD1010BB11F.

The Food and Agriculture Organization of the United Nations developed the Global Livestock Environmental Assessment Model (GLEAM), motivated by the rapid growth of the livestock component of the global agricultural economy. This review described the structure, methods, and application along with the technical-improvement needs of GLEAM as it applies to understanding environmental impacts of livestock.

Climate change impacts on selected global rangeland ecosystem services. Boone, R.B., R.T. Conant, J. Sircely, P. K. Thornton, and P. Herrero. 2018. *Global Change Biology* 24:1382–1393. https://onlinelibrary.wiley.com/doi/pdf/10.1111/gcb.13995.

This paper uses a relatively new model called G-Range to simulate how net primary production (NPP) in the earth's rangelands may respond to projected changes in climate. NPP is projected to decline by 2050 with losses near $10 billion, though this may vary with increases in rangelands of North America and decreases in portions of Africa and Australia.

Marketing Livestock and Meat. Lesser, W.H. 2018. CRC Press. https://www.crcpress.com/Marketing-Livestock-and-Meat/Lesser/p/book/9781560220176.

This new book describes the basic operations of the "meat market," with an emphasis on dynamic changes in meat products and their relationship to market competition and trade barriers, the U.S. and especially the increasing international market outlets, changing human consumer demographics, and health concerns about red meat. This book could be useful in understanding market controls on the livestock industry.

Integrating decision triggers into conservation management practice. De Bie K., P.F.E. Addison, and C.N. Clark. 2018. *Journal of Applied Ecology* 55:494–502. https://doi.org/10.1111/1365-2664.13042.

Use of adaptive management is increasingly common on rangelands, and it entails an act–monitor–assess–repeat cycle that requires identifying "decision triggers"—usually rangeland outcomes that will trigger actions such as changes in grazing or application of treatments. Decision triggers need to be determined a priori, and doing this is not trivial, partly because processes and methods for their determination are often not developed. Although not on rangelands specifically, this perspective paper provides a generalizable outline of the necessary steps along with a useful summary of the diversity of triggers.

Long-term trends in restoration and associated land treatments in the southwestern United States. Copeland, S.M., S.M. Munson, D.S. Pilliod, J.L. Welty, J.B. Bradford, and B.J. Butterfield. 2018. *Restoration Ecology* 26:311–322. https://onlinelibrary.wiley.com/doi/pdf/10.1111/rec.12574.

This study synthesizes ~4,000 treatments on Bureau of Land Management lands across the southwestern United States. In recent decades, seeding and plant–soil treatments have declined, and prescribed fire and weed treatments have increased. Treatments have become larger, their costs have increased, and treatments have tended to be applied in drier years.

Applying a dryland degradation framework for rangelands: The case of Mongolia. Jamsranjav, C., R.S. Reid, M.E. Fernández-Giménez, A. Tsevlee, B. Yadamsuren, and M. Heiner. 2018. *Ecological Applications.* Online first, early view. https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/eap.1684.

Two rangeland degradation frameworks were compared across the diverse steppe rangeland types across Mongolia, and

their agreement to other rangeland assessments is described. The framework integrates cover, biomass, palatability, species richness, forage quality, gaps, and soil-surface characteristics. The area characterized as severely degraded was <18% of the study domain, compared with 33% to 53% in slight and 25% to 40% in moderate states of degradation. It was stronger in the steppe compared with desert steppe, especially mountain and eastern steppes.

Modelling interacting plant and livestock renewal dynamics helps disentangle equilibrium and nonequilibrium aspects in a Mongolian pastoral system. Joly, F., R. Sabatier, and B. Hubert. 2018. *Science of The Total Environment* 635:1390–1404. https://www.sciencedirect.com/science/article/pii/S0048969717336495?via%3Dihub.

This paper models the interaction of plant and livestock "renewal dynamics" and how they relate to interactions among herders under different climate scenarios in the Gobi Desert. Those with larger herds may have a competitive advantage under current conditions, owing to density dependence on livestock productivity and response to climate variation.

Traits determining the digestibility–decomposability relationships in species from Mediterranean rangelands. Bumb, I., E. Garnier, S. Coq, J. Nahmani, M. Del Rey Granado, O. Gimenez, and E. Kazakou. 2018. *Annals of Botany* 121:459–469. https://academic.oup.com/aob/article/121/3/459/4791874.

For 16 species, digestibility was positively related to decomposability. Digestibility was related to fiber and nitrogen content, and decomposability was related to traits in living rather than senesced tissue.

Aridity and overgrazing have convergent effects on ecosystem structure and functioning in Patagonian rangelands. Gaitán, J.J., D.E. Bran, G.E. Oliva, M.R. Aguiar, G.G. Buono, D. Ferrante, V. Nakamatsu. et al. 2018. *Land Degradation & Development* 29:210–218. https://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.2694.

In Argentina, the suitability of landscape function analysis (LFA) indices (stability, infiltration, and nutrient cycling) to indicate soil functioning over 239 sites was evaluated. The LFA indices were correlated with soil organic carbon and texture. Sites with less precipitation and more grazing had lower species richness, palatable grasses, and soil functioning.

Relationship between socioeconomic vulnerability and ecological sustainability: The case of Aran-V-Bidgol's rangelands, Iran. Raufirad, V., Q. Heidari, R. Hunter, and J. Ghorbani. 2018. *Ecological Indicators* 85:613–623. https://www.sciencedirect.com/science/article/pii/S1470160X17307215.

In the county of Iran, a study combining questionnaires and measurements of plant cover and forage yield found that socioeconomic vulnerability of rangeland users is most affected by factors such as how many use an area, their economic status, their access to expert consultants, and type of livestock and use patterns.

Analyzing root traits to characterize juniper expansion into rangelands. Chesus, K.A., and T.W. Ocheltree. 2018. *Journal of Arid Environments* 150:1–8. https://www.sciencedirect.com/science/article/pii/S0140196317302434.

This paper reports field data on stable isotopes of water and direct measurements of roots on juniper and big sagebrush. The authors make conclusions about competitive interactions in juniper.

Effects of propagule pressure and priority effects on seedling recruitment during restoration of invaded grassland. Schantz, M.C., R.L. Sheley, and J.J. James. 2018. *Journal of Arid Environments* 150:62–70. https://www.sciencedirect.com/science/article/pii/S0140196317302318.

Restoring perennial grasses where exotic annuals threaten native perennials is often challenging. In a field experiment in sagebrush steppe, perennial grass establishment was enhanced by sowing seeds in fall versus spring in areas where annual grass seeds were scarcer.

Using germination prediction to inform seeding potential: I. Temperature range validation of germination prediction models for the Great Basin, USA. Cline, N.L., B.A. Roundy, and W.F. Christensen. 2018. *Journal of Arid Environments* 150:71–81. https://www.sciencedirect.com/science/article/pii/S014019631730229X.

Using germination prediction to inform seeding potential: II. Comparison of germination predictions for cheatgrass and potential revegetation species in the Great Basin, USA. Cline, N.L., B.A. Roundy, S. Hardegree, and W.F. Christensen. 2018. *Journal of Arid Environments* 150: 82–91. https://www.sciencedirect.com/science/article/pii/S0140196317302306.

This pair of papers uses field data from sites around the Great Basin and wet–degree day models to evaluate germination patterns of many seedlots and species in the context of restoration of plant communities after burning or shredding of encroaching trees.

Fire and grazing modulate the structure and resistance of plant–floral visitor networks in a tallgrass prairie. Welti, E.A.R., and A. Joern. 2018. *Oecologia* 186:517–528. https://link.springer.com/article/10.1007/s00442-017-4019-9.

Pollinators are important but understudied components of many rangeland ecosystems. Using ecological-network analysis on a decadal and landscape study, this paper revealed that ungulate grazing increased richness of plant and floral visitor species and decreased network nestedness, and fire had more complex impacts on community networks such as increasing specialization. How fire-grazing interactions impact resilience to plant and pollinator species loss is addressed.