



By Matt Germino

Browsing the Literature

For this edition of *Browsing the Literature*, my scanning of journal table-of-contents and internet searches using search terms like *rangelands*, *grazing*, *livestock*, or more specific terms tended to reveal papers published in the last 1 to 2 months regarding greenhouse gas or climate effects, fire, restoration, and grazing impacts. At the end of the list, we have a recommended paper from David Pilliod. If you find papers outside of *Rangeland Ecology and Management* or *Rangelands* that are relevant for future editions, please email me about them (mgermino@usgs.gov).

Unexpected reversal of C₃ versus C₄ grass response to elevated CO₂ during a 20-year field experiment. Reich P.B., Hobbie, S.E., Lee, T.D., and Pastore, M.A. 2018. *Science* 360 (6386):317–320. <http://science.sciencemag.org/content/360/6386/317> DOI: 10.1126/science.aas9313.

Grass species using the C₃ photosynthetic pathway, which tend to be relatively more common in cooler or wetter rangelands, are considered to benefit more from elevated CO₂ concentrations than species using the C₄ photosynthetic pathway. However, in a long-term, free-air CO₂ enrichment experiment in the upper midwestern United States, biomass initially increased more in plots having C₃ species, but in the most recent 8 years, biomass increased in C₄ but not C₃ plots. This is yet another demonstration that long-term observations of vegetation responses are critical for guiding our science and management.

Commentaries, Reviews, or Broad Analyses Regarding Climate, Fire, or Restoration

Staged-scale restoration: Refining adaptive management to improve restoration effectiveness. Bakker, J.D., Delvin, E.G., and Dunwiddie, P.W. 2018. *Journal of Applied Ecology* 55:1126–1132. <https://doi.org/10.1111/1365-2664.13050>.

This commentary proposes “stage-scale restoration” as an alternative or modification to the adaptive management paradigm. Their approach involves testing alternative restoration methods on a site using the basic principles of experimentation, then operationally applying the best methods and observing the responses, and finally applying the most successful approach to the full spatial scale and later stages of the area of concern. An example of application is given for prairie restoration.

Human-related ignitions concurrent with high winds promote large wildfires across the USA. Abatzoglou, J.T., Balch, J.K., Bradley, B.A., and Kolden, C.A. 2018. *International Journal of Wildland Fire*. In Press. <https://doi.org/10.1071/WF17149>.

Across the United States, larger fires occurred during warmer and drier conditions than did smaller fires. Large human-caused fires occurred when wind speeds were greater. This paper covers more than rangelands, but the findings are very relevant.

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

These authors tallied the number, type, and cost of treatments such as seedings and plowing, predominantly of rangelands, from 1940 to 2010 in the southwestern United States, using records archived in the US Geological Survey's Land Treatment Digital Library. A trend toward larger, more costly, and fire- and weed-focused treatments was apparent over time.

State lines, fire lines, and lines of authority: Rangeland fire management and bottom-up cooperative federalism. Abrams, J., Wollstein, K., and Davis, E.J. 2018. *Land Use Policy* 75:252–259. <https://doi.org/10.1016/j.landusepol.2018.03.038>.

Rangeland Fire Protection Associations (RFPAs) are relatively new agreements between US federal land agencies, mainly the Bureau of Land Management, and state and local governments, which enable those living and thus nearest to remote areas to conduct fire suppression activities on federal land. Previously, fire suppression could be done primarily only by the land agencies or their delegates. This paper describes the arrangements and how differences in the governance of two states—Idaho and Oregon—relate to the RFPAs.

Effects of climate change on rangeland vegetation in the Northern Rockies. Reeves, M.C., Manning, M.E., DiBenedetto, J.P., Palmquist, K.A., Lauenroth, W.K., Bradford, J.B., and Schlaepfer, D.R. 2018. In: *Climate Change and Rocky Mountain Ecosystems* (pp. 97–114). Eds: Halofsky, J.E., Peterson, D.L. Springer International Publishing. <https://www.springerprofessional.de/en/effects-of-climate-change-on-rangeland-vegetation-in-the-norther/13315260>.

This book chapter reviews the impacts of growing season length, elevated CO₂, and effects of cheatgrass and other weed invasions on fire patterns. Management responses and strategies are reviewed.

Grazing Effects: Abandoned pastures cannot spontaneously recover the attributes of old-growth savannas. Cava, M.G.B., Pilon, N.A.L., Ribeiro, M.C., and Durigan, G. 2018. *Journal of Applied Ecology* 55:1164–1172. <https://besjournals.onlinelibrary.wiley.com/doi/abs/10.1111/1365-2664.13046>.

Based on plant community measurements across a chronosequence of 29 abandoned pastures and different reference sites in the Brazilian Cerrado, restoration intervention is required to prevent woody plant invasion and increase native grasses, forbs, and shrubs, and promote the species diversity that is typical of old-growth savanna. Passive restoration alone will result in a lower diversity, arrested succession state woodland.

Revision of a state-and-transition model to include descriptions of state functional attributes. Tipton, C.Y.,

Ocheltree, T.W., Mueller, K.E., Turk, P., and Fernandez-Gimenez, M.E. 2018. *Ecosphere* 9:e02201. <https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecs2.2201>.

In sagebrush-steppe, sites were considered to be in diverse (intact) or depauperate (increased bare ground and shrub dominance) states that could be modeled using a state-and-transition framework. Litter quantity and quality, nitrogen mineralization, and other soil attributes were measured in replicate sites of each state condition. Depauperate sites had greater bulk density with less clay and soil moisture, less nitrogen, and much greater litter patchiness. Soil texture is proposed to be a factor affecting transitions among these generalized state conditions.

Rewilding the uplands: the effects of removing sheep grazing on soils and plants. Marrs, R., Rasal, J., Sanchez, R., Connor, L., Blackbird, S., and Rose, R. 2018. In: *Ecosystem and habitat management: research, policy, practice* (pp. 83–90). Eds: Feber, R., Jones, N., Marrs, R., Mortimer, S., Peters, C., Rotherham, I., Sparks, T., Westbury, D. Wellesbourne Association of Applied Biologists (*Aspects of Applied Biology*, 139). <http://nora.nerc.ac.uk/id/eprint/519969>.

In the North Pennines, soils and the quantity and nutritional quality of vegetation did not differ many years after long-term experimental exclusion of sheep grazing from 1954 to 1967. These factors varied more with elevational differences among the plots, compared with if sheep had been excluded.

The impact of heavy grazing on soil quality and pasture production in rangelands of SW Spain. Pulido, M., Schnabel, S., Lavado Contador, J.F., Lozano-Parra, J., and González, F. 2018. *Land Degradation & Development* 29: 219–230. <https://onlinelibrary.wiley.com/doi/abs/10.1002/ldr.2501>.

Livestock numbers have increased in the last 30 years in NW Spain. Over 3 years and 22 livestock enclosures on 10 farms, bare soil, erosion, and bulk density of soil were greater where stocking rates were greater than 1 AU ha⁻¹. Bulk density was negatively related to pasture production and quality.

Feral horses influence both spatial and temporal patterns of water use by native ungulates in a semi-arid environment. Hall, L.K., Larsen, R.T., Knight, R.N., and McMillan, B.R. 2018. *Ecosphere* 9(1):1–15. <https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/ecs2.2096>.

Remote cameras were placed at 32 water sources in the Great Basin and were observed for 4 years. Use of the water sources by pronghorn plus mule deer was inversely related to use by wild horses, implying competition. There was also a shift in the timing of use of water sources by pronghorn that was associated with horse use, but no change in timing for mule deer, probably because mule deer normally make more use of water sources at night, whereas horses make diurnal use.

Rodent, snake and raptor use of restored native perennial grasslands is lower than use of unrestored exotic annual grasslands. Wolf, K.M., Whalen, M.A., Bourbour, R.P., and Baldwin, R.A.. 2018. *Journal of Applied Ecology* 55:1133–1144. <https://doi.org/10.1111/1365-2664.12990>.

In the Central Valley of California, areas that were reseeded to native perennial grasses 13 to 24 year prior to sampling had fewer rodents, such as deer mice, and fewer predator species than did unrestored areas dominated by annual grassland. The patterns can be explained by requirements of the animals for different vegetation structures.

Labile soil organic matter in response to long-term cattle grazing on sloped rough fescue grassland in the foothills of the Rocky Mountains, Alberta. Zhang, B., Thomas, B.W., Beck, R., Liu, K., and Hao, X. 2018. *Geoderma* 318:9–15. <https://www.sciencedirect.com/science/article/pii/S0016706117318025>.

Soil organic carbon and total nitrogen of most labile organic carbon forms were less in grazed compared with ungrazed areas, but the relationship was modulated by slope.

Legacy effects of historical grazing affect the response of vegetation dynamics to water and nitrogen addition in semi-arid steppe. Chen, Q., Wang, Z.L., Zou, C.B., Fan, Y., Dittert, K., and Lin, S. 2018. *Applied Vegetation Science* 21:229–239. <https://doi.org/10.1111/avsc.12364>.

In summer-wet Mongolian steppe, nitrogen and water additions were experimentally applied to areas that had relatively high or low livestock stocking rates for 6 years. Irrigation increased nitrogen pool sizes and cycling rates, as well as abundance of perennial species on

sites which had high stocking rates. In contrast, on sites with moderate stocking rates, irrigation decreased nitrogen pool sizes and nitrogen cycling and increased a species that is indicative of degradation. Nitrogen addition increased abundance of annual species. The combination of irrigation and nitrogen addition increased nitrogen pool sizes and cycling at the moderately grazed site only, and increased abundance of tall perennials at both sites.

Guest Highlight

Our guest paper highlight this week comes from Dr. David Pilliod, Supervisory Research Ecologist with the US Geological Survey in Boise. He recommends the following paper:

Fire and grazing influence site resistance to *Bromus tectorum* through their effects on shrub, bunchgrass, and biocrust communities in the Great Basin (USA). Condon LA, Pyke DP. 2018. *Ecosystems*. In Press. <https://doi.org/10.1007/s10021-018-0230-8>.

On almost 100 sampling locations in the Great Basin, structural equation modeling revealed that cheatgrass abundances increase more due to plant community composition than to fire or grazing disturbances per se. This study provides evidence that the effect of the disturbances on cheatgrass is mediated by altered plant community condition.

<https://doi.org/10.1016/j.rala.2018.05.002>