



By Matt Germino

Browsing the Literature

For this edition of Browsing the Literature, we have several papers that transcend rangeland ecosystems in their analyses of drought impacts. One notable paper evaluates shifts in ecosystem use of moisture across the globe using remote sensing (Bernardino et al. 2020), and another notable paper makes strides in our understanding of the molecular basis for physiological tolerance of drought (Pardo et al. 2020).

Matt Germino, 20 Aug 2020

Global papers

Global-scale characterization of turning points in arid and semi-arid ecosystem functioning

Bernardino, P.N., De Keersmaecker, W., Fensholt, R., Verbesselt, J., Somers, B. and Horion, S. 2020. *Global Ecology and Biogeography*, 29(7), pp. 1230–1245.

<https://doi.org/10.1111/geb.13099>

A time-series segmentation technique was used to separate seasonal shifts from trends and thresholds in rain-use efficiency (RUE, ratio of net primary productivity and precipitation) from annual Landsat images in arid and semi-arid regions globally from 1982–2015 (Figure 1). Over 10% of regions exhibited turning points (see Figure 2, for examples), with distinct reductions in RUE in North America compared to increases in the Sahel, Central Asia, and Australia. Climate shifts and human-related disturbance correlated with the changes in North America, whereas drought related more to the changes in Sahelian grasslands, and disturbance was the main correlate of change in Asia and Australia. (Figures reproduced with permission.)

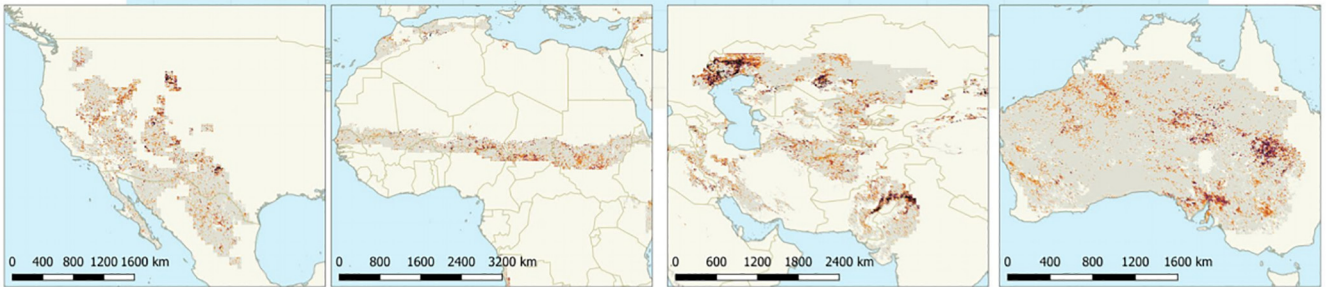
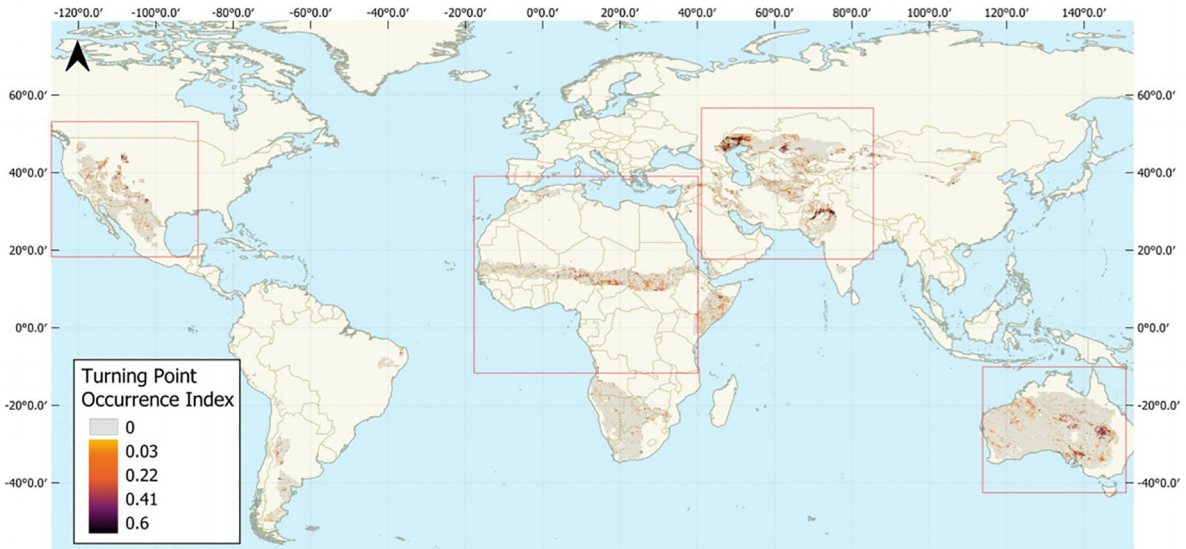


Figure 1. Turning point occurrence index (TPOI) map. Darker color represents areas with a higher certainty of the occurrence of a turning point (TP) in ecosystem functioning and its associated timing. Hotspots of TP occurrence are observable, mainly in the highlighted regions (i.e., central-western North America, the Sahel, north-western Central Asia, and Australia).

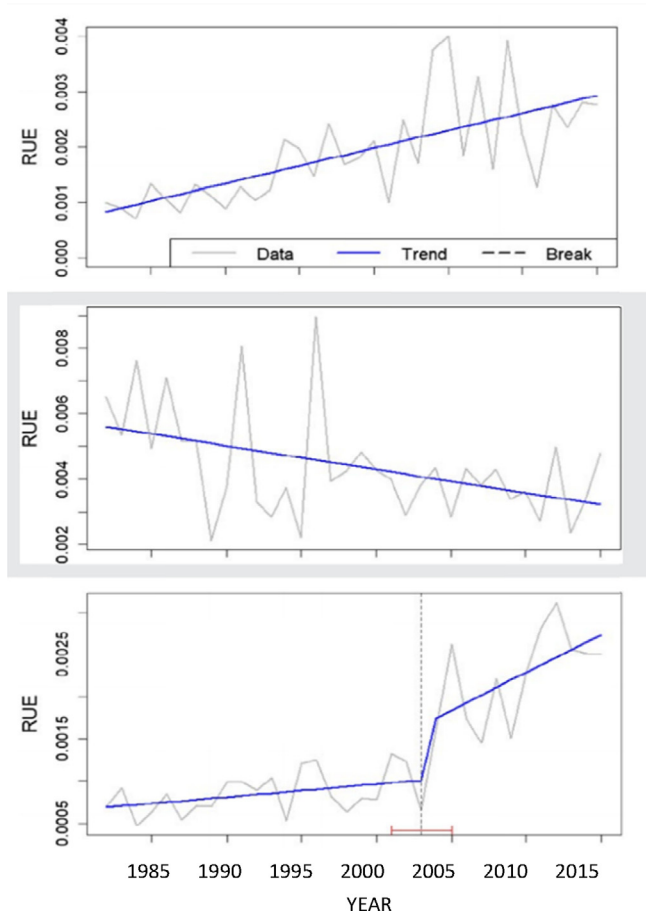


Figure 2. Examples of changes in rain-use efficiency (RUE, net primary productivity/annual precipitation) for specific regions across years. The top panel represents a site affected by increased CO₂ and temperature, the middle panel represents a disturbed and degraded site suffering from a progressive loss of organic matter, and the bottom panel represents a site that experienced rapid change in plant species composition.

Intertwined signatures of desiccation and drought tolerance in grasses

Pardo J., Man Wai, C., Chay, H., Madden, C.F., Hilhorst, H., Farrant, J.M., Van Buren, R. 2020. *Proceedings of the National Academy of Sciences* 117(18):10079–10088; DOI: <https://doi.org/10.1073/pnas.2001928117>

What are the genetic underpinnings of physiological resistance to drought and desiccation in grasses? Comparative genomics of the desiccation-tolerant grass, *Eragrostis nindensis*, with its desiccation-sensitive congener, *Eragrostis tef*, during dry-down experiments suggest that seed dormancy related genes, which are commonly assumed to underly water-stress responses, were expressed broadly and were not informative to understanding interspecific differences in desiccation tolerance. Instead, mechanisms such as resistance to sunlight damage (photooxidation) during desiccation appeared to distinguish the species, specifically the activity of early light-induced proteins (ELIPS) that regulate chlorophyll cycling. Sunlight stress coincides with water deficit in the habitat of many rangelands grass species.

An ecological framework for contextualizing carnivore–livestock conflict

Wilkinson, C.E., McInturff, A., Miller, J.R., Yovovich, V., Gaynor, K.M., Calhoun, K., Karandikar, H., Martin, J.V., Parker-Shames, P., Shawler, A. and Van Scoyoc, A., 2020. *Conservation Biology*. 34:854–867. <https://doi.org/10.1111/cobi.13469>

A framework to describe ecological drivers of predation on livestock was developed from ecological theory (e.g. density-dependence, optimal foraging) and published studies on predators and domestic prey interactions. The framework was applied to management of snow leopards, wolves, and cougars.

USA papers

Evaluating winter annual grass control and native species establishment following applications of Indaziflam on rangeland

Clark, S.L., Derek J.S., Nissen, S.J., and Sebastian, J.R. *Invasive Plant Science and Management*: 1–37. <https://doi.org/10.1017/inp.2020.23>.

On three grassland sites in the Colorado Front Range, USA, the pre-emergent herbicide indaziflam (known by its label name Rejuva) led to substantial reductions in exotic annual grasses and increases in desirable perennials three years post-treatment.

Pasture management, grazing, and fire interact to determine wetland provisioning in a subtropical agroecosystem

Sonnier, G., Quintana-Ascencio, P.F., Bohlen, P.J., Fauth, J. E., Jenkins, D.G., and Boughton, E.H. 2020. *Ecosphere* 11(8): e03209. <https://doi.org/10.1002/ecs2.3209>

The effects of pasture management intensity, cattle exclusion, prescribed fire, and their interactions were evaluated in a full-factorial experiment on 40 small, isolated, and seasonally flooded wetlands in subtropical pastures and rangelands in Florida (USA). Fencing to exclude cattle nearly doubled the productivity, biomass, and the amount of palatable species. The pasture type surrounding each wetland affected treatment responses.

Reintroduced grazers and prescribed fire effects on beetle assemblage structure and function in restored grasslands

Nelson, M., Hosler, S.C., Boetzel, F.A., Jones, H.P. and Barber, N.A. 2020. *Ecological Applications*. doi: <https://doi.org/10.1002/eap.2217>

Ground beetle assemblages were measured in response to tallgrass prairie restoration efforts using prescribed fire and bison in the midwestern U.S., along with seed and arthropod predation. Beetle assemblages varied with restoration age, declining over time in richness and both taxonomic and functional diversity, but bison presence influenced taxonomic composition. Overall, the beetle responses to treatments were minor, which is a promising sign that these restoration efforts are not detrimental to beetle assemblages.

Management of remnant tallgrass prairie by grazing or fire: effects on plant communities and soil properties

Larson, D.L., Hernández, D.L., Larson, J.L., Leone, J.B., and Pennarola, N. 2020. *Ecosphere* 11(8):e03213. <https://doi.org/10.1002/ecs2.3213>

The effects of cattle grazing or fire on vegetation and soil characteristics were evaluated in 73 prairie sites in north/midwestern US. They found that grazing and fire result in similar C storage and vegetation responses, and both are required to maintain maximum diversity.

Asia and Africa papers

Annual Landsat time series reveal post-Soviet changes in grazing pressure

Dara, A., Baumann, M., Freitag, M., Hölzel, N., Hostert, P., Kamp, J., Müller, D., Prishchepov, A.V., and Kuemmerle, T., 2020. *Remote Sensing of Environment*, 239: <https://doi.org/10.1016/j.rse.2020.111667>

Landsat data were used to assess changes in grassland conditions in Kazakhstan (360,000 km²) from 1985 to 2017, which notably includes a >70% reduction in heavy grazing following the shift away from Soviet dominance in 1991. A binary random forest classification of many spectral indices had the greatest explanatory power and correlated to field measurements of dung pile abundance and herbaceous biomass.

Mixed-species groups of Serengeti grazers: a test of the stress gradient hypothesis

Beaudrot, L., Palmer, M.S., Anderson, T.M. and Packer, C. 2020. *Ecology*. doi:<https://doi.org/10.1002/ecs.3163>

In 115,000 camera trap observations in the Serengeti-Mara over five years, mixed-species groups of ungulates were more likely to occur in areas having greater predation risks and when resources were more abundant. The patterns are consistent with the stress-gradient hypothesis that has been evaluated primarily for plant communities and rarely for animals.

Heterogeneity of soil structure and fertility during desertification of alpine grassland in northwest Sichuan

Ma, L., Wang, Q., Shen, S., Li, F., and Li, L. 2020. *Ecosphere* 11(7):e03161. <https://doi.org/10.1002/ecs2.3161>

These authors performed a detailed spatial analysis of soil properties across degradation gradients and found that the fractal dimension of properties was related to soil aggregation and thus soil stability and site condition.

Rangelands 42(5):168–171

doi: <https://doi.org/10.1016/j.rala.2020.08.002>

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