



By Matt Germino

Browsing the Literature

This edition of Browsing the Literature contains forthcoming papers I have found, in addition to new and recently published papers on the topic of fire behavior and suppression in Mediterranean areas, brought forward by Dr. Devan McGranahan, Assistant Professor of Range Science at North Dakota State University. While the papers he has summarized are not necessarily on rangelands per se, the issues addressed are nonetheless relevant. Any paper below that does not have a volume and page number in the citation was "in press" and available online at the time the column was submitted for publication. As always, please let me know of forthcoming literature in rangeland ecology and management (mgermino@usgs.gov). If you provide a summary using the style and format below, I will also include it and acknowledge you.

-Matt Germino

General papers

Archibald, S., Hempson, G.P. and Lehmann, C. 2019. A unified framework for plant life history strategies shaped by fire and herbivory. *New Phytologist*.

The reciprocal interactions of plant species and fire or herbivory, i.e. the effects and responses of plants on these processes, are typically considered separately even though they are related by factors such as loss of above-ground biomass and moisture content. Moreover, fire and herbivory interact because one "consumer" affects the other, i.e. grazing can reduce wildfire fuels and vice versa. This concept paper describes how grass traits related to fire or grazing, such as tolerances to either, or flammability or palatability, can be used to understand diversity of different "consumer regimes".

Siero, E., Siteur, K., Doelman, A., Koppel, J.V.D., Rietkerk, M. and Eppinga, M.B. 2019. Grazing away the resilience of patterned ecosystems. *The American Naturalist*, 193(3), pp.472-480.

This review of theoretical models of grazing effects in drylands confirms that biomass shifts induced by overgrazing causes degradation at precipitation levels that would normally sustain productivity. They find that grazing causes degraded sites to be resilient to change, such as restoration.

Damgaard, C.F. and Irvine, K.M. 2019. Using the beta distribution to analyze plant cover data. *Journal of Ecology*.

The beta distribution has been recognized as the most suitable for the non-normal distributions that are often observed in plant cover data, and relatively new computational software options in R and other packages are available to facilitate beta distribution analyses.

Zhou, G., Luo, Q., Chen, Y., Hu, J., He, M., Gao, J., Zhou, L., Liu, H. and Zhou, X. 2019. Interactive effects of grazing and global change factors on soil and ecosystem respiration in grassland ecosystems: a global synthesis. *Journal of Applied Ecology*.

A meta-analysis was done on experiments that manipulated grazing, precipitation, and/or warming or nitrogen deposition and measured soil and ecosystem respiration. Grazing and drought decreased soil respiration, and nitrogen addition or irrigation increased respiration. All treatments increased ecosystem respiration except drought, which decreased it.

From North America

Shinneman, D.J., Germino, M.J., Pilliod, D.S., Aldridge, C.L., Vaillant, N.M. and Coates, P.S. 2019. The ecological uncertainty of wildfire fuel breaks: examples from the sagebrush steppe. *Frontiers in Ecology and the Environment*.

Linear treatments that reduce wildfire fuels have been implemented or are proposed over a large portion of the vast rangelands in the western US to break connectivity in wildfires (i.e., reducing their spread) to prevent further loss of connectivity and fragmentation of wildlife species that are fire intolerant. This review highlights the lack of studies on fuel breaks.

Rigge, M., Shi, H., Homer, C., Danielson, P. and Granneman, B. 2019. Long-term trajectories of fractional component change in the Northern Great Basin, USA. *Ecosphere*, 10(6), p.e02762.

An automated method for mapping plant cover from annual Landsat scenes is described and applied over the Northern Great Basin, USA, over a 30-year period. Shrub cover decreased and bare ground increased over the period, and the changes were related to variability in water-year precipitation and temperature extremes, such as increasing in response to warmer minimum temperatures, especially in the coolest regions.

Young, K.E., Bowker, M.A., Reed, S.C., Duniway, M.C. and Belnap, J. 2019. Temporal and abiotic fluctuations may be preventing successful rehabilitation of soil-stabilizing biocrust communities. *Ecological Applications*, p.e01908.

Biological crusts had similar effects as plants in reducing erosion in Bandelier National Monument, New Mexico, USA. Biological crusts reared in greenhouses were used to inoculate eroding soils in an experiment, along with barriers including flashing or seeded perennials to minimize runoff. Soil stability, penetration resistance, and nutrients changed considerably during the experiment, but not in response to treatments.

Chung, Y.A., Collins, S.L. and Rudgers, J.A. 2019. Connecting plant-soil feedbacks to long-term stability in a desert grassland. *Ecology*, p.e02756.

In a semiarid grassland of the southwestern USA, plant community patches that exhibited little variation over long time periods had more evidence of negative plant-soil feedbacks, growing less with conspecific soil biota.

Chambers, J., Brooks, M.L., Germino, M.J., Maestas, J.D., Board, D., Jones, M.A., and Allred, B.W. 2019. Operationalizing resistance and resilience concepts to address invasive grass-fire cycles. *Frontiers in Ecology and Evolution*.

This paper reviews the patterns of resistance to exotic plant invasion and resilience to disturbances such as fire for rangelands around the world, and provides guidance on how the concepts can be used for management actions, drawing on sagebrush steppe of the Western USA as an example.

Shriver, R., Andrews, C., Arkle, R., Barnard, D., Duniway, M., Germino, M., Pilliod, D., Pyke, D., Welty, J., and Bradford, J. 2019. Transient population dynamics impede restoration and may promote ecosystem transformation after disturbance. *Ecology Letters*.

Restoration of dry areas, such as burned rangelands, is challenging and often unsuccessful. Whereas much emphasis is placed on limitations to success of early demographic stages of the perennial species being restored, this paper uses long-term data from hundreds of plots in the Great Basin USA to show that restored populations of sagebrush typically decline 10-15 years after initial establishment due to slow growth and lack of reproduction in newly established plants. These internal demographic limitations are referred to as “transient population dynamics” internal to the population being restored.

From Europe

Pakeman, R.J., Fielding, D.A., Everts, L. and Littlewood, N.A. 2019. Long-term impacts of changed grazing regimes on the vegetation of heterogeneous upland grasslands. *Journal of Applied Ecology*.

Tripling sheep, excluding them, or mixing them with cows over the long-term were experimentally evaluated in the United Kingdom. Increased grazing favored several grass species, while exclusion favored several shrub species and a forb species. Acid-soil grasslands exhibited fewer responses, and less productive wet sites had increased responses.

Tonn, B., Densing, E.M., Gabler, J. and Isselstein, J. 2019. Grazing-induced patchiness, not grazing intensity, drives plant diversity in European low-input pastures. *Journal of Applied Ecology*.

The response of three community patch types differing in vegetation height to three levels of long-term grazing were evaluated in Germany. Patch type but not grazing intensity most affected plant diversity. Both patch type and grazing intensity affected vegetation composition.

From Asia, Australia, or South America

Oliva, G., Paredes, P., Ferrante, D., Cepeda, C. and Rabinovich, J. 2019. Remotely-sensed primary productivity shows that domestic and native herbivores combined are overgrazing Patagonia. *Journal of Applied Ecology*.

Net primary productivity images were compared to field-aerial net primary productivity (ANPP) data for 66 sites and used along with carrying capacity to create a harvest index as the proportion of primary productivity that can be sustainably consumed by cattle, goats, and native wild camelids (guanacos). Guanacos increased (0.5 to 2 M) over a recent 15-year period, causing grazing to be 36% to 62% above carrying capacity in southern Patagonia provinces.

Fensham, R.J., Laffineur, B., Rhodes, J.R. and Silcock, J. L. 2019. Rare plant species do not occupy water-remote refuges in arid environments subject to livestock grazing. *Ecological Applications*, p.e01911.

Whether rare species are constrained to livestock-protected areas was evaluated in the northeastern Australian arid zone using presence records for 45 species. The findings suggest that short-lived plants are resilient to livestock grazing, probably because they often complete their key life history stages in brief periods of soil moisture availability. In contrast, long-lived palatable species are at greater risk of grazing impacts.

Jamsranjav, C., Fernández-Giménez, M.E., Reid, R.S. and Adya, B. 2019. Opportunities to integrate herders' indicators into formal rangeland monitoring: An example from Mongolia. *Ecological Applications*, p.e01899.

Interviews with herders were used to discover indicators they use and how they relate to indicators used by researchers, in Mongolia. Herders' indicators were similar to those used by researchers.

Special section on fire in Mediterranean environments from Dr. Devan McGranahan:

The Wildland-Urban Interface (WUI)

Badia, A., Pallares-Barbera, M., Valdeperas, N. and Gisbert, M. 2019. Wildfires in the wildland-urban interface in Catalonia: Vulnerability analysis based on land use and land cover change. *Science of the Total Environment* 673, pp.184-196.

Regional fire scenarios in Spain: Linking landscape dynamics and fire regime for wildfire risk management. C.M. Molina, O. K. Martín, and L. G. Martín. 2019. *Journal of Environmental Management* 233: 427-439.

Alcasena, F.J., Ager, A.A., Bailey, J.D., Pineda, N. and Vega-García, C. 2019. Towards a comprehensive wildfire management strategy for Mediterranean areas: Framework development and implementation in Catalonia, Spain. *Journal of Environmental Management* 231, pp.303-320.

These three recent studies address landscape-level wildfire risks and management strategies for Mediterranean Spain. They attempt to take fire management beyond reactive,

emergency suppression by enabling landscape-level planning with anticipated fire occurrence, behavior, and resource needs. This is facilitated by grouping fuel, landscape, and fire behavior complexes into typologies and wildland fire scenarios. Fire-prone regions of Europe are impacted by two different forms of land-use change: spread of suburban areas, and depopulation of rural areas that results in large tracts of land reaching late seral stages. This can include afforestation and increases in the continuity and overall fuel load.

Tessler, N., Borger, H., Rave, E., Argaman, E., Kopel, D., Brook, A., Elkabets, E. and Wittenberg, L. 2018. Haifa fire restoration project—urban forest management: a case study. *International Journal of Wildland Fire*.

This paper offers a case study on post-fire restoration, in which restoration planning began with controlling soil erosion and matching plantings to dominant vegetation and local topography. The authors describe what they call the first "urban fire" in Israel—a 120-ha fire that started in the WUI and spread into the city of Haifa.

Godoy, M.M., Martinuzzi, S., Kramer, H.A., Defossé, G. E., Argañaraz, J. and Radeloff, V.C. 2019. Rapid WUI growth in a natural amenity-rich region in central-western Patagonia, Argentina. *International Journal of Wildland Fire*.

This study found that the WUI comprised less than 7% of central-western Patagonia but contained 97% of the buildings, and the WUI has grown by 75% since 1981. The fact that nearly 80% of fires in this area occurred in the WUI underscores the need for WUI-focused management.

Florec, V., Burton, M., Pannell, D., Kelso, J. and Milne, G. 2019. Where to prescribe burn: the costs and benefits of prescribed burning close to houses. *International Journal of Wildland Fire*.

This study considered fires that moved into the WUI from surrounding wildlands and addressed fuel treatments within and outside of the WUI. Reducing fuel loads are a priority for fire managers in the WUI worldwide: lower fuels reduce the probability of an ignition spreading, and lower fuels generally reduce intensity, causing less damage and increasing success of suppression efforts. Prescribed fires within WUIs are more effective but also more expensive than prescribed fires outside of WUIs.

Fire suppression effectiveness and safety

Rodrigues, M., Alcasena, F. and Vega-García, C. 2019. Modeling initial attack success of wildfire suppression in Catalonia, Spain. *Science of the Total Environment* 666, pp.915-927.

Most of Europe has a total fire exclusion policy, meaning wildland fires are to be extinguished at all costs. The first resources to respond to an ignition and ideally prevent it from growing into a major incident are called Initial Attack. This study begins by noting (a) the largest fires are those that escape

Initial Attack (IA), and (b) regardless of how insistent policy is on suppression at all costs, budgets and resources can't grow infinitely; thus, understanding the drivers of IA effectiveness is critical. A machine-learning model revealed that the wildfires most likely to escape IA occurred in hot and windy conditions > 12.5 km from the nearest fire station and when multiple fire events were occurring (> 10).

Russell-Smith, J., Edwards, A.C., Sangha, K.K., Yates, C. P. and Gardener, M.R. 2019. Challenges for prescribed fire management in Australia's fire-prone rangelands—the example of the Northern Territory. *International Journal of Wildland Fire*.

In very low human population density in vast flammable landscapes in Northern Australia, there are few barriers to fire spread, and fires are predominantly started by humans. Prescribed fire management is focused around—and spatially limited to—settled areas.

Molina-Terrén, D.M., Xanthopoulos, G., Diakakis, M., Ribeiro, L., Caballero, D., Delogu, G.M., Viegas, D.X.,

Silva, C.A. and Cardil, A. 2019. Analysis of forest fire fatalities in Southern Europe: Spain, Portugal, Greece and Sardinia (Italy). *International Journal of Wildland Fire* 28 (2), pp.85-98.

There have been 865 wildfire fatalities in Mediterranean Europe since 1945. These numbers have risen substantially since 1978—most recently, in 2018, when 99 lives were lost in Greece in one day; in two days, 119 persons in Portugal died in 2017. The majority of these fatalities were civilians (interestingly, 86% of whom were male), which differs from the US media focus on firefighter deaths (310 firefighters were killed in the US between 1990–2006). The study cites vegetation structure, weather patterns, and social changes as drivers of wildland fire fatalities, emphasizing the importance of adaptability in ensuring altered fire regimes can be managed safely.

Rangelands 41(4):191—194

doi 10.1016/j.rala.2019.06.004

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