EGU2020-12758, updated on 24 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-12758
EGU General Assembly 2020

Fire frequency influenced grazed grasslands' resistance and resilience to extreme drought

Xiran Li[1,2], Olivia Hajek[2,3], Jillian LaRoe[3,4], Kate Wilkins[2,3], Alan Knapp[2,3], and Melinda D. Smith[2,3]
[1]Key Laboratory for Geographical Process Analysis & Simulation of Hubei Province, College of Urban and Environmental Sciences, Central China Normal University, Wuhan, China
[2]Department of Biology, Colorado State University, Fort Collins, CO 80523, USA
[3]Graduate Degree Program in Ecology, Colorado State University, Fort Collins, CO 80523, USA
[4]Warner College of Natural Resources, Colorado State University, Fort Collins, CO 80523, USA

Grasslands provide critical ecosystem functions and services globally, including forage production for livestock and other animals. As frequency and intensity of disturbances, including fire and drought, are increasing globally, grasslands and the services they provide are particularly vulnerable. In this changing environment, resistance, the capacity to withstand disturbance, and resilience, the capability to recover from disturbance, are important for the stability of grassland ecosystems during and after extreme climate events. Quantifying how grazed grassland's resistance and resilience respond to these disturbances provides important information of stability of grassland function under forecast climate change.

In this study, we focus on fire experiments in grasslands located in the Kruger National Park in South Africa (tropical savanna grassland) and the Konza Prairie Biological Station in the US (mesic temperate grassland). Both sites experienced extreme drought (SPEI <-2) this past decade, in 2015 and 2012, respectively. Further, both sites have long-term fire frequency treatments (annually burned, burned every 3-4 years and unburned) that are grazed by large native herbivores (~14 species at Kruger and bison at Konza), which allows us to explore influences of fire frequency on grazed grassland's resistance and resilience to extreme drought. Using Landsat remote sensing data, we generated 30 m x 30 m NDVI monthly time series for each fire frequency treatment and conducted repeated measures ANOVA to compare the vegetation productivity two years before, during, and two years after the extreme one-year drought events.

Although large reductions in productivity occurred during the extreme drought at both sites and across the grazed fire frequency treatments, full recovery of production was observed the following year, consistent with trends observed in ungrazed grasslands at the study sites. These results suggest that grazed grasslands show high resilience, but low resistance to extreme drought. However, the degree of resistance and resilience was influenced by fire frequency. At Konza, during and after extreme drought in 2012, unburned grassland showed the lowest resistance but higher resilience, while grassland burned every four years and annually had higher resistance but relatively lower resilience. The anomaly of NDVI at Kruger exhibited an opposite pattern. These differences in resistance and resilience of production to extreme drought across

the fire frequency treatments are likely due to changes in species composition or ecosystem structure (i.e., increased density of woody species in the absence of fire). Ultimately, these results suggest that fire frequency plays an important role in grazed grassland ecosystems' vulnerability to extreme drought.