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Impact of drought and precipitation seasonality on net primary production and plant community composition across a grassland ecotone in New Mexico

Scott Collins, Michell Thomey, Renee Brown, Nate Gehres, Matthew Petrie, Kristin Vanderbilt, and William Pockman

University of New Mexico, Department of Biology, Albuquerque, United States (scollins@sevilleta.unm.edu)

In the southwestern US, climate change will impact the amount, timing and variability of rainfall during the summer monsoon. Changes in amount and seasonality of precipitation are likely to affect plant community dynamics and ecosystem processes, especially along ecotones. In 2012, we established a rainfall manipulation experiment (EDGE-Extreme Drought in Grasslands Experiment) in Chihuahuan Desert grassland (CDG) dominated by black grama and shortgrass steppe (SGS) dominated by blue grama across a grassland ecotone in central New Mexico. EDGE includes two rainfall treatments, chronic drought (∼66% reduction in monsoon rainfall) and altered timing of the summer monsoon. Chronic drought is imposed from July through September by rainout shelters with roof panels that cover 66% of the surface area. To alter precipitation seasonality complete rainout shelters are erected in July and August, and all rainfall that occurred during this period is captured, stored, and then reapplied in several large rain events during September and October. Thus, this treatment receives the same amount of precipitation as ambient but differs in seasonality and frequency of rain events. We measured soil moisture, aboveground net primary production (ANPP), and plant species composition in each replicate (n=10) of each treatment at CDG and SGS sites. There were no significant pre-treatment differences in ANPP or plant species richness at either site. In 2013 following an above average monsoon, ambient ANPP was 99.4 g m-2 at CDG and 44.3 g m-2 at SGS. Event size reduction resulted in a 75% reduction in ANPP at CDG but only a 33% reduction in ANPP at SGS. Shifting the monsoon to later in the growing season resulted in a 50% and 43% reduction in ANPP at CDG and SGS, respectively. Thus, ANPP at CDG partially recovered from the mid-summer drought with late season precipitation but SGS did not. Event size reduction also resulted in a decrease in species richness at CDG, but not at SGS. These short-term results suggest that chronic drought and changes in precipitation seasonality are likely to have significant impacts on grassland communities across this ecotone. The ability of black grama grassland to recover to a greater extent than blue grama suggests that CDG may continue to expand northward replacing SGS vegetation under a changing precipitation regime.