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Differential Sensitivity to Drought in Central U.S. Grasslands Arrayed Along an Aridity Gradient

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Responses to drought often vary dramatically among terrestrial ecosystems, but the reasons why are unclear. With climate change forecasts for more frequent, severe and extensive drought in the future, a more complete understanding of the mechanisms that determine differential ecosystem sensitivity to drought is needed. In 2012, the Central U.S. experienced the 4th largest drought in a century, with a regional-scale 40% reduction in growing season precipitation affecting ecosystems ranging from desert grassland to mesic tallgrass prairie. This provided an opportunity to assess ecosystem sensitivity to a natural drought of common magnitude in six native grasslands. We tested the prediction that drought sensitivity would be inversely related to mean annual precipitation (MAP) by quantifying reductions in aboveground net primary production (ANPP). Long-term ANPP data available for each site (mean length = 16 yrs) were used as a baseline for calculating reductions in ANPP, and drought sensitivity was estimated as the reduction in ANPP per mm reduction in precipitation. Arid grasslands were the most sensitive to drought, but drought responses and sensitivity varied by more than 2-fold among the six grasslands, despite all sites experiencing similar relative reductions in growing season precipitation. Although drought sensitivity generally decreased with increasing MAP as predicted, there was evidence that the identity and traits of the dominant species, as well as plant functional diversity, influenced sensitivity. Results from this natural drought will be compared with responses to an experimentally imposed drought to determine if patterns of sensitivity are consistent between experimental and observational approaches.