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Resistance of a grassland ecosystem to multiple drought events

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Climate extremes, such as severe drought, are forecast to be more frequent and severe with climate change. As a consequence, such events will become increasingly important drivers of future ecosystem dynamics and function. We experimentally imposed an extreme growing season drought over two years in a central US grassland, allowed the ecosystem to recover for two years, and then imposed a second drought of similar magnitude. The first (2-yr) drought reduced aboveground net primary productivity (ANPP) below the lowest level measured in this grassland for almost thirty years. The extreme reduction in ecosystem function with the first drought was a consequence of reduced productivity of the two dominant functional groups in this grassland - C4 grasses and C3 forbs. However, the most abundant (dominant) C3 forb was negatively impacted by the drought more than the dominant C4 grass. This differential sensitivity led to a reordering of species abundances within the plant community. Yet, despite this large shift in plant community composition, which persisted post-drought, ANPP recovered completely the year after drought. This rapid recovery in function was due to the dominant C4 grass compensating for loss of the dominant C3 forb. However, despite the rapid post-drought recovery, the ecosystem was more susceptible to a second drought of similar magnitude, with productivity reduced more in the previously droughted plots than those experiencing drought for the first time. Overall, our results suggest that low resistance of ecosystem function to an extreme climatic event does not preclude rapid ecosystem recovery, but may lead to greater vulnerability to future climate extremes.