IMPACTS OF CLIMATE CHANGE

CLIMATE CHANGE IN NATIVE AND INTRODUCED GRASSLANDS

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Introduction

Covering 22% of the Earth's ice-free land surface, grasslands have been manipulated by mankind since Neolithic times, particularly in temperate regions where sown pastures are established in high fertility areas, and extensive grazing undertaken in areas not suitable for other forms of agriculture (Kuneš et al., 2015). These grasslands are vital to food security and are as important as forests in reducing the CO_2 concentration in the atmosphere (Mannetje, 2007). Below is a brief summary of a review on the impact of climate change in native and introduced grasslands.

Summary

Climate change and grassland management are highly interconnected in determining the future of these ecosystems. Intensive agricultural systems can be modified to adapt to changing conditions (e.g. irrigation, cultivar selection) but conversely, such grasslands are more vulnerable to climate-driven loss of plant species diversity than low fertility, natural grasslands (Tylianakis and Binzer, 2014; Voigt et al., 2007). Such reductions in plant diversity can result in cascading effects on the richness and structure of grassland interaction networks and vulnerability to invasions.

The relative simplicity of grassland ecosystems means they are well represented in studies of how climate change impacts on terrestrial communities and food webs (Barton and Schmitz, 2009; de Sassi et al., 2012; Laws and Joern, 2015; Tylianakis and Binzer, 2014). Different trophic levels appear to have different sensitivities to climate change, and these sensitivities are ordered with increasing trophic rank (producers, < herbivores, < predators and parasitoids) (Thomson et al., 2010 and references therein). Climatic extremes, rather than gradual shifts, may create the greatest disruptions to grassland food webs by causing larger lags and disconnections between host and enemy populations (Stireman et al., 2005). Past grassland weed and pest outbreaks have been related to major El Niño events, the frequency and amplitude of which is expected to intensify.

Individually, warming appears to have a lesser effect on grassland biodiversity than changes in CO_2 and rainfall, but the largest changes occur when all three attributes are combined. Concurrent elevated temperature and CO_2 are expected to increase plant production and lead to changes in herbage nutritive value, plant phenology, grass–endophyte symbioses and plant secondary metabolites. How these changes will impact on grassland biological control systems will vary with community.

The open nature of grasslands means invertebrates are exposed to greater thermal extremes than those under tree and shrub habitats (Suggitt et al., 2011). Therefore phenotypic plasticity and behavioural responses in seeking thermal refuges may determine the resilience of

species interactions and grassland food web structure and function (Schmitz and Barton, 2014). In addition, plants and animals in temperate grasslands are moving in response to recent changes in climate at 0.59 km yr^{-1}, a higher rate than the global mean of 0.42 km yr^{-1} (Loarie et al., 2009).

Conclusions

The effects of climate change on grassland ecosystems are complex. However, because of their scale, ability to be easily manipulated, and relatively rapid response to changing conditions, they enable researchers to explore and quantify the multiple effects climate change may have on our terrestrial ecosystems. Such understanding will ultimately enable informed decisions in ecosystem management in a changing world, from conservation of biodiversity to economic and environmentally sustainable agricultural practices.

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