

## RESEARCH ARTICLE

# Joint forcing by heat waves and mowing poses a threat to grassland ecosystems: Evidence from a manipulative experiment

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## Abstract

The frequency and intensity of heat waves (HWs) have increased in recent years, but it remains unclear how grassland ecosystems respond to such extreme weather. A 3-year manipulative field experiment was conducted to simulate HWs under different mowing intensities in a *Stipa krylovii* steppe on the Mongolian Plateau to examine their effects on plant morphology, phenology, and community. At the species level, the morphology and phenology of the three main herb species (*S. krylovii*, *Melilotoides ruthenica*, and *Potentilla tanacetifolia*) showed species-specific responses to the HW and mowing treatments. The major dominant species *S. krylovii* shed ~50% of the tiller outer layer to protect the internal tiller from HW stress thereby directly decreasing the heat load and water loss from green plant tissue and indirectly increasing the litter biomass. HWs also caused increases of community index (richness, diversity, and evenness) but also associated with a 30% decrease in the importance value of *S. krylovii*, whereas mowing enhanced this value by 27%. When HWs were combined with mowing, the joint forcing of mechanical damage and low carbon accumulation aggravated negative effects of stress on plant health and growth, which further decreased community index. We constructed a framework to fully describe the effects of HWs and mowing and their interrelationship on different ecological levels and explain how short-term effects, such as extreme climate, produce long-term effects on ecosystems. In conclusion, we found that synergisms between climate extremes (HWs) and human activities (mowing) can reduce ecosystem stability posing a threat to the grasslands.

## KEYWORDS

climatic extremes, steppe, clipping, plant community, phenology