# Climate and Grazing Interact to Control Rangeland Vegetative Characteristics at a Regional Scale on the Tibetan Plateau

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# Climate and grazing interact to control rangeland vegetative characteristics at a regional scale on the Tibetan Plateau

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**Key words :** climate change , grazing , Tibetan Plateau , biodiversity , biomass

**Introduction** Rangeland degradation on the Tibetan Plateau is often attributed to overgrazing . However , the effects of on-going climate changes , and their interactions with grazing , are rarely explored . In previous work , we demonstrated that experimental warming decreased plant diversity , plant aboveground production , and resulted in less palatable shrubs replacing more palatable graminoids ; these effects were dampened by grazing (Klein et al . , 2004 & 2007) . Here , we compared the shorter-term , site-scale experimental responses to the longer-term , regional-scale responses .

**Materials and methods** We sampled four sites along a 700 km transect in Qinghai Province , China on the NE region of the Tibetan Plateau . The sites ranged from 320-560mm of mean annual precipitation and from -3 .5℃ to 3 .5℃ mean annual temperature . At each site along this transect , we sampled inside fenced areas where large herbivore grazing had been excluded for 40 years and outside of the fenced areas where dormant-season grazing occurred . We measured plant species richness through documenting plant species presence/absence in all plots and measured aboveground peak standing biomass through direct vegetative harvests .

**Results** Mean annual precipitation , not temperature , was positively associated with aboveground vegetative biomass and species richness across non-grazed and grazed plots . The difference in biomass and richness between the wettest and the driest sites was three times greater in the grazed than in the non-grazed plots . Grazing effects on vegetative properties depended on site precipitation . Grazing decreased at drier sites and increased at wetter sites both biomass and species richness (Figure 1) .

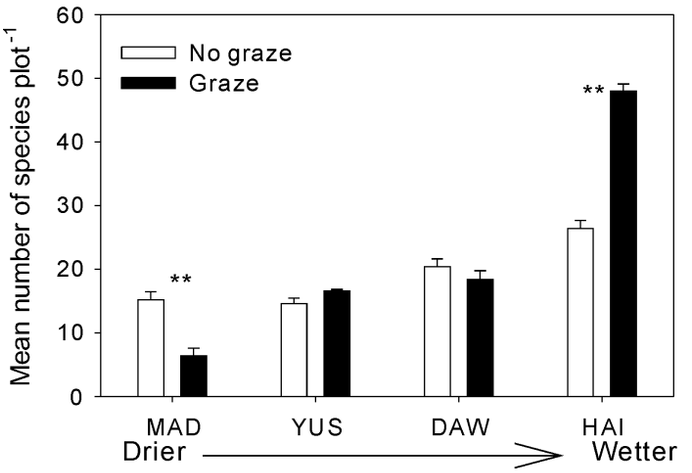


**Figure 1** *Grazing effexts on species richness across sites .*

**Discussion** The positive association between mean annual precipitation and vegetative characteristics is consistent with results from other semi-arid grassland systems . However , the lack of an association between mean annual temperature and vegetative characteristics contradicts the findings from the experimental manipulations . There may be both an ecological and methodological explanation for these opposing results at different scales . Our findings are consistent with previous work which demonstrates the strong role of precipitation in mediating the vegetative response to grazing ; however , the observed direction of the response was novel . To develop a comprehensive understanding of grazing effects on plant characteristics , we need to differentiate between dormant versus growing season grazing as the mechanisms driving the responses differ .

**Conclusions** Both climate and grazing interact to affect the rangelands of the Plateau . While there may be a large , negative response of biomass and richness to climate warming , over the very long-term these properties may recover . However , future changes in precipitation and grazing regimes may have large , non-linear , and persistent effects on vegetation . Grazed systems may be more sensitive to future changes in precipitation than non-grazed systems . Predictions of future precipitation-induced changes in ecosystem properties may underestimate the magnitude of change that will occur in grazed systems .

**References**

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