

Effects of short- and long-term plant functional group loss on alpine meadow community structure and soil nutrients

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Abstract

We conducted a comprehensive investigation of the interrelationships among the species diversity, productivity, community structure, and soil nutrients of vegetation communities of an alpine meadow ecosystem on the eastern Qinghai–Tibet Plateau. We performed biodiversity manipulation experiments to examine the effects of removing plant functional groups (Gramineae, Cyperaceae, Legumes, and other Forbs) for 3 and 10 years at a research station in Haibei. Interannual variation in the species richness and above- and belowground biomass of the community gradually decreased over time. Species richness and productivity were positively correlated, and this correlation became increasingly significant over time. Removal of the plant functional groups resulted in fewer Gramineae species within the community. However, soil total nitrogen, phosphorus, organic matter, and moisture contents increased significantly in the Legume removal treatment. The removal of other Forbs led to the lowest negative cohesion values, suggesting that this community may have had difficulty recovering its previous equilibrium state within a short period of time. The effects of species removal on the ecosystem were likely influenced by the species structure and composition within the community. Changes in the number of Gramineae species indicated that they were more sensitive and less resistant to plant functional group removal. Legume removal may also have indirectly caused distinct community responses through starvation and compensation effects. In summary, species loss at the community level led to extensive species niche shifts, which caused community resource redistribution and significant changes in community structure.

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