

Diversity responses of an understory plant community in *Juniperus przewalskii* forest to soil properties along an elevation gradient in China

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Abstract: **【Objective】** Plant diversity, as an essential component of biodiversity, provides abundant resources and environmental conditions for human survival. It serves as a crucial indicator of species richness and the evenness of plant community distribution within ecosystems. Plant diversity is currently facing severe challenges due to global environmental changes and human activities. The Qinghai-Tibet Plateau, known as the "Third Pole of the Earth", boasts a rich variety of plant species and numerous high-altitude endemics. However, understanding of how species diversity responds to soil properties that distinguish community types along the elevation gradient remains limited.

【Method】 Nine *Juniperus przewalskii* natural forest with different elevation gradient (The elevation gradient was divided into nine levels from 3000 to 3800m a.s.l. at 100 m intervals) but similar site conditions were selected as experimental plots. Four replicate plots at each elevation gradient were randomly assigned for a total of 36 plot. The distance between each replicate was not >3 km. To facilitate repeated sampling, a fixed sampling plot of 20 × 30 m was established in each plot. The identity, quantity, diameter at breast height, height, and canopy density of tree species were recorded in each sample plot. Additionally, we focused on investigating and recording the characteristics of shrubs and herbs such as quantity, identity, height, coverage, etc. The α and β diversity indices were applied to describe the traits of the community. **【Result】** (1) We found that elevation had a significant effect on soil pH, SOC, soil AN and AP, SOC:AN, SOC:AP and AN:AP (all $p < 0.05$), but no effect on SWC and SBD (all $p > 0.05$). (2) This survey identified 128 plant species representing 30 families and 79 genera. In the herb layer, 110 species were found among 27 families and 71 genera. A total of 6 families, 9 genera, and 18 species were surveyed at the shrub layer. (3) The species richness and Shannon-Wiener of shrub and herb layers exhibited an initial increase followed by a subsequent decrease with increasing elevation, reaching their peak at 3400 m a.s.l. (4) The shrubs exhibited their peak C_j and C_s with the elevation range of 3400 m to 3500 m, whereas herbs demonstrated their maximum between 3600 m and 3700 m. We found that β_w and β_c in shrub layers showed a "W"-shaped distribution trend. The shrub layer had the highest β_w and β_c at 3300-3400 m a.s.l. Unlike shrubs, we found that β_w and β_c in the herb layers showed a decreasing and then increasing trend with elevation gradient with the highest rate of species substitution at 3300-3400 m. (5) The random forest analyses showed that species richness and Shannon-Wiener of shrub layer were positively correlated with AP, and that of herb layer were regulated negatively by soil pH. **【Conclusion】** Our results revealed that, soil available phosphorus and soil pH were important factors affecting species richness in the shrub and herb layers, respectively. These results contributed to a deeper understanding of the distribution patterns of plant communities in forest ecosystems along elevation gradients, and provide insights into the complexity of plant diversity.