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Research Paper

Terrain impacts the composition of the persistent soil seed bank: A case study of steep high mountain grasslands in the Greater Caucasus, Georgia

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Abstract

Aims: Under global climate and land use change, the vegetation layer of steep high mountain slopes is prone to increasing disturbance via erosion and mass-wasting events. The ecological restoration and stabilization of an intact vegetation layer on steep slopes with the soil seed bank is therefore an important factor for functional high mountain ecosystems. We analyze the relationships between the soil seed bank composition, topography, and land use and compare the plant species composition of the aboveground vegetation to the soil seed bank. Study area: Stepantsminda, Georgia, Greater Caucasus (1,800–2,500 m a.s.l.). **Methods:** 74 grassland vegetation relevés (5 × 5 m) on steep high mountain slopes were compared to the respective persistent soil seed bank (0–5 cm depth), assessed via the seedling emergence method. Non-metric multidimensional scaling and vector fitting uncovered the relationships between topography, land use, and soil on the seed bank and aboveground vegetation composition. The similarity between both datasets was assessed with a Mantel test. Vegetation types were described with indicator species analysis for both aboveground and belowground plant species composition. **Results:** Exposure to the north and incoming solar radiation relate to seed bank composition, as well as the belowground species diversity, whereas the effect of land use on the soil seed bank remains unclear. The similarity between the aboveground vegetation and the soil seed bank is generally low (18% shared species, Mantel test r = 0.21, no common indicator species). **Conclusions:** The higher seed density and belowground species richness on intensively illuminated and pastured south-exposed slopes imply a higher restoration potential in the case of disturbance events such as mass-wasting. However, the overall moderate diversity within the soil seed bank challenges the restoration of the aboveground grassland, especially on north-exposed slopes.

Keywords: Belowground species composition; Greater Caucasus; plant diversity; revegetation potential

Taxonomic reference: Gagnidze (2005) and The Plant List 1.1 (http//www.theplantlist.org, Accessed 16 February 2018)

Abbreviations: AC = *Astragalus captiosus*; ISA = Indicator species analysis; NMDS = Non-metric multidimensional scaling; PC = *Polygonum carneum*; RM = *Rhinanthus minor*

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Introduction

The steepness of the terrain is directly linked to the threat of soil erosion. Therefore, a dense, diverse, slope-protecting vegetation cover is of great importance for high mountain grasslands (Körner 2003; Martin et al. 2010). Subalpine grasslands (1,800–2,500 m a.s.l., in the Kazbegi region, Greater Caucasus Georgia), especially on steep slopes, are commonly species rich (Sakhokia 1983; Nakhutsrishvili et al. 2013). However, these grassland ecosystems are currently affected by changes in climate and land use (Bekker et al. 1997; Körner et al. 2004; Magiera et al. 2013). Not only overgrazing, but also the abandonment (MacDonald et al. 2000) of traditional grazing and mowing practices negatively affect species diversity, vegetation cover, and therefore erosion mitigation within

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