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SCALE-DEPENDENT EFFECTS OF FOREST EDGES ON MOUNTAIN GRASSLAND BIOGEOCHEMISTRY

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Abstract

Current landscapes have been intensively modified by humans and forest fragmentation has created substantial increases of forest edges. So far, scale-dependence between observable ecological patterns and the underlying processes affected by forest fragmentation have been widely ignored. To overcome the widespread ambiguity in selecting relevant spatial scales for studying the ecological effects of forest fragmentation, we investigated the effect of forest prevalence and edge length on carbon stocks, organic matter and plant-available nutrients (nitrate and ammonium) across varying spatial scales in a temperate mountainous grassland landscape of Romania. We calculated forest prevalence and edge length in the surroundings of 60 grassland plots with different spatial extents and quantified the effects of both factors on grassland productivity and soil biogeochemistry. We found a strong decreasing effect of forest edge length on soil carbon stock and organic matter and a contrasting increased effect on plant-available nutrients in the range of 100 m to 300 m radius, particularly for nitrate in the first 150 m (marginal $r^2=0.22 \pm 0.02$, $p<0.1$). As the scale increased, we identified either an increasing tendency for carbon stock, organic matter and plant-available nutrients or an almost constant effect across the range of scales. Grassland above-ground biomass showed no clear trend with scale. In this study, we observed that the effect of forest prevalence and edge length on grassland soil biogeochemistry and productivity strongly varied with the spatial scale of investigation. Such profound scale-dependence of key ecosystem properties must be considered in management strategies aiming for sustainable ecosystem functioning.

Key words: carbon storage, edge effects, nitrogen availability, scale, spatial heterogeneity

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