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Spatial patterns of vegetation in sub-humid badlands: a case study from the Central Spanish Pyrenees

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Soil erosion is one of the most severe processes of land degradation in the Mediterranean region, especially in badland areas. Badlands are usually defined as “intensely dissected natural landscapes where vegetation is sparse or absent and which are useless for agriculture”. Although badlands occupy a relatively small fraction of the Mediterranean area, their erosion rates are significant. Several studies dealt with the influence of vegetation on erosion. This study, however, contributes to the recently growing interest in the reverse impact of erosion on vegetation development.

Most research on badland dynamics was mainly conducted in the more abundant semi-arid badland environments. Here, water availability constitutes the main limiting factor for vegetation development. As a consequence, south-facing slopes are less vegetated due to a very large water stress. However, these findings do not necessary apply to sub-humid badland environments. Therefore the main objectives of this study are (i) to assess spatial patterns of vegetation cover and composition in a sub-humid badland environment in the Central Spanish Pyrenees, (ii) to determine topographic thresholds for plant colonization, and (iii) to contrast these findings to those obtained in semi-arid badlands.

179 representative plots (2mx2m) all having different aspect and gradient on sub-humid badland slopes in the Inner Depression (Central Spanish Pyrenees) were selected. For each plot, vegetation cover and number of plant species were determined. These data allow an evaluation of the relationship between slope gradient and vegetation cover as well as vegetation composition, for each slope aspect.

The results show that vegetation cover decreases when slopes become steeper and no vegetation is observed above a critical slope gradient. The highest vegetation cover and the largest critical slope gradient are observed for south-facing slopes, contrasting to the results from semi-arid badlands. As slope steepness increases, vegetation development is hampered because of the struggle for equilibrium between gravitational and cohesion forces. However, this inhibitive effect of slope gradient on plant colonization capacity appears to vary with slope orientation. Which underlying processes can explain this orientation-influenced discrepancy? In contrast to semi-arid environments, water availability is not a limiting factor for vegetation growth since sub-humid badlands receive over 800 mm of annual precipitation. A more plausible explanation is the frequent occurrence of freezing and thawing processes on north-facing slopes and the related high intensity of geomorphic processes. A deeper understanding of the processes that limit vegetation establishment in sub-humid badlands might guide future initiatives aimed at reducing sediment yield in these environments.