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Soil characteristics and plant exotic species invasions in the Grand Staircase—Escalante National Monument, Utah, USA

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Abstract

The Grand Staircase—Escalante National Monument (GSENM) contains a rich diversity of native plant communities. However, many exotic plant species have become established, potentially threatening native plant diversity. We sought to quantify patterns of native and exotic plant species and cryptobiotic crusts (mats of lichens, algae, and mosses on the soil surface), and to examine soil characteristics that may indicate or predict exotic species establishment and success. We established 97 modified-Whittaker vegetation plots in 11 vegetation types over a 29,000 ha area in the Monument. Canonical correspondence analysis (CCA) and multiple linear regressions were used to quantify relationships between soil characteristics and associated native and exotic plant species richness and cover. CCA showed that exotic species richness was significantly ($P < 0.05$) associated with soil P ($r = 0.84$), percentage bare ground ($r = 0.71$), and elevation ($r = 0.67$). Soil characteristics alone were able to predict 41 and 46% of the variation in exotic species richness and cover, respectively. In general, exotic species invasions tend to occur in fertile soils relatively high in C, N and P. These areas are represented by rare mesic high-elevation habitats that are rich in native plant diversity. This suggests that management should focus on the protection of the rare but important vegetation types with fertile soils.

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