GEOMORPHOLOGICAL INFLUENCES ON PHYSICAL AND BIOLOGICAL CHARACTERISTICS OF SPRINGS ECOSYSTEMS, GRAND CANYON ECOREGION, SOUTHWESTERN USA

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The Grand Canyon Ecoregion (GCE) occupies the Grand Canyon drainage on the southern Colorado Plateau and is a topographically diverse landscape with a wide array of environments and corresponding plant communities. Springs are numerous in the GCE and provide critical sources of water that support many rare, endemic, and some endangered springs-dependent species. We conducted a statistical analysis to distinguish geomorphologic influences on physical and vegetation differences among four regionally common spring types – helocrene wet meadows, hanging gardens, rheocrene flowing springs, and hillslope springs (total N = 350 springs). As in other studies of springs, we detected remarkably high species packing, with 45% of the region's entire flora found in 0.45 km^2 (<0.01% of the landscape). The four springs types were distinguished by differences in physical characteristics, which in turn were associated with plant community structure and species distributions. Elevation, geochemistry, and geomorphic diversity (i.e., microhabitat features, including substrate composition), differed among springs types and were strongly correlated with plant assemblage characteristics. A unique suite of indicator plant species were associated with each spring type: hanging gardens were characterized by ferns, orchids, and other native species, while hillslope and rheocrene springs supported more generalist species, and helocrenes (which often are heavily grazed) were characterized by non-native species. Multivariate regression analysis identified suites of variables related to springs plant biodiversity, explaining nearly half of the variation in species richness between springs. Microhabitat richness, area, and elevation were most influential factors affecting plant species richness. Although grazing intensity was negatively related to the diversity of non-native plant species found at springs. While this study identified key differences between springs types, springs ecosystems are highly individualistic and expanded inventory is needed to improve understanding of springs biodiversity. Stewardship actions that identify and protect an array of springs across elevation, as well as protecting rare springs types is likely the best way to conserve springs-dependent species across the GCE and throughout the nation.