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Altitudinal soil and vegetation transitions in alpine desert, the Central Great Caucasus, Georgia

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Alpine deserts are noteworthy habitats in high mountain systems such as the Caucasus. However, very little is known on the soil properties in these habitats. Another unexplored question is the transition between subnival (lower part of alpine desert) and nival (upper part of alpine desert) belts. We studied soils and vegetation in an alpine desert along its practically entire elevation range (3000-4000 m a.s.l.) on two contrasting slope aspects (north vs south) of Mt. Kazbegi, the Central Great Caucasus, Georgia. Vegetation with standardized stratified-random design and collected soil samples for measuring pH, soil organic content (SOM) and available nutrients (N, P, K) were sampled; the collected data were analyzed with direct gradient methods as well as multivariate ordination. 63 species were recorded and, as expected, strong dependence of species distribution on elevation and between slopes was documented. We found that soil pH increased monotonically with altitude on both N and S slopes and reached alkaline values with bare bedrock. The changes were steeper on the northern slope than on the southern slope, and, remarkably, many relatively abundant species changed their preference to slope aspect from N to S in parallel with the increasing difference in soil pH. We suspect that the pH observed shift in slope preference, at least in part, can be explained by the effect of different soil pH. As for SOM, it decreased from very low values to zero at the higher altitudes, whilst available nutrients dropped dramatically and predominantly multispecific vegetation patches characteristic for subnival belt changed abruptly to monospecific patches or solitary plants typical for nival belt. These abrupt changes occurred at 3400-3500m a.s.l., and most probably indicate a vegetation switch between the mentioned belts on Mt. Kazbegi.

Overall, our results show two characteristics of alpine desert vegetation and soils, which have not been documented to date: (1) an unexpected change of slope preference of many relatively abundance plants which probably is associated with different soil pH profiles on N and S slopes, and (2) a vegetation switch between subnival and nival belts that occurs at relatively lower elevations than expected from the concept of alpine-nival ecotone.