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Vaccinium vitis-idaea decreases the dependence of alpine soil properties from soil moisture

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Climatic and plant community changes are observed in the alpine belt of the Teberda Reserve (the Northwest Caucasus) in the last decades. Increase of average monthly temperature in the summer months in 2006-2018 was 1.8-2.2 ºC in comparison with 1966-1990. For the last 13 years, the maximum temperature in July and August reached 22.1-23.2 ºC vs. 20.5 ºC in 1966-1990, and minimum temperature during these months did not fall lower than -1.8 ºC whereas in 1966-1990 it fell up to -7.0 ºC. At the same time decrease of summer precipitation, especially in July and August is observed (average 80-100 mm per month vs. 150-160 mm in 1966-1990). Against this climatic background, a significant increase of dwarf shrub with ericoid mycorrhizal symbiosis (Vaccinium vitis-idaea) occurs in plant community of alpine lichen heath. As ericoid mycorrhiza is characterized by high enzymatic activity capable to transform and mobilize soil organic matter, we assume that the appearance of Vaccinium vitis-idaea in grass ecosystems can change soil properties. Simultaneously the observed tendency to decrease the amount of summer atmospheric precipitation in mountain regions can change soil moisture which is also highly important to control soil microbial activity and organic matter transformation.

The properties of the mountain-meadow soil of the alpine lichen heath, characterizing labile forms of carbon, nitrogen and phosphorus, as well as biological activity at different soil moisture and in the presence or absence of Vaccinium vitis-idaea in the plant community, have been studied. It has been shown that under V. vitis-idaea soil is characterized by greater acidity and less responsive to changes in soil moisture. Differences in properties in the presence and absence of V. vitis-idaea are predominantly determined by the expressed response of the soil to changes in moisture in the absence of dwarf shrub. Under herbal vegetation, when soil moisture decreases, concentrations of inorganic nitrogen, activity of N-mineralization and nitrification, microbial biomass and soil respiration decrease, but concentrations of labile organic carbon and nitrogen, and enzymatic activity increase. Such changes indicate a shift in organic matter transformation from mineralization to depolymerization, more characteristic of ectomycorrhizal and ericoid mycorrhizal dominated ecosystems. Thus, both factors (soil moisture and invasions of ericoid mycorrhizal plant species) should be taken into account in predicting changes of alpine ecosystems functioning.

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