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Long-term effects of N, P and K fertilization on mountain grassland vegetation: productivity, species composition and plant N:P stoichiometry*

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Abstract

Increased nutrient availability, especially nitrogen and phosphorus from fertilization and pollution, affects plant communities. Nutrient concentrations in plant tissues and their stoichiometric ratios can indicate nutrient availability. This study aimed to evaluate the use of nutrient concentrations and stoichiometric ratios as indicators of nutrient addition effects on productivity, species composition, and functional group proportions in a mountain meadow. In a long-term grassland experiment in the Polish Carpathians, various fertilizer combinations (90NPK, 180NPK, N, P, PK, control) and liming were applied. Over 39 years, species composition was assessed, and nitrogen, phosphorus, and potassium concentrations in plant biomass were measured. Liming had no effect on vegetation parameters or nutrient concentrations. The N:P ratio remained low across all treatments, ranging from 4.9 in 90NPK to 11.7 in 90N, suggesting nitrogen limitation. Despite significant variations in species composition and productivity between the NPK-fertilized treatments and the remaining treatments, the N:P ratio varied only slightly. The N:P ratio was influenced not only by nutrient availability but also by other factors, such as the capacity of some species characteristic of oligotrophic habitats to accumulate excess nitrogen in the 90N treatment, and the increase in the proportion of nitrogen-fixing legumes following potassium application in the PK treatment. Conclusion: Stoichiometric ratios may serve as useful indicators of nutrient effects on vegetation; however, they should be interpreted with because they are also affected by various environmental factors.

Keywords: nitrogen, phosphorus, vegetation stoichiometry, mountain grassland, plant functional groups

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