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Nitrogen uptake patterns by snow addition in a sub-Arctic dry heath tundra ecosystem

The Arctic heath tundra ecosystem is undergoing rapid transformations driven by climate change, which particularly affects snow accumulation and the length of the growing season. In this study, I examined the influence of snow depth on parameters such as water content, soil temperature, microbial activity, and nutrient availability and investigated their implications for plant water availability and nitrogen cycling processes. Through snow fence experiments and ^{15}N isotope labelling and simulations of carbon fluxes with the CoupModel, I found that a longer growing season positively impacted plant productivity, carbon accumulation, and nutrient assimilation. Both evergreen and deciduous plants benefited from an extended growing season, but when the growing season was shortened, evergreen species exhibited greater resilience, while deciduous species were more susceptible to detrimental effects on growth and photosynthesis. Non-growing season alterations in snow cover could have intricate consequences on annual photosynthesis and greenhouse gas emissions, as increased snow depth favored microbial activity in winter and resulted in higher carbon dioxide emissions. These emissions counteracted the carbon sequestration advantages of the growing season, underscoring the importance of considering both the duration of the growing season and snow dynamics in conservation and management strategies.

Keywords: Physical Geography and Ecosystem analysis, Arctic ecosystem, snow accumulation, growing season length, nutrient availability, carbon sequestration, greenhouse gas emissions, climate change impacts, CoupModel.

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