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Responses of competitive understorey species to spatial environmental gradients inaccurately explain temporal changes

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Understorey plant communities play a key role in the functioning of forest ecosystems. Under favourable environmental conditions, competitive understorey species may develop high abundances and influence important ecosystem processes such as tree regeneration. It is thus important for managers to be able to predict accurately the abundance response of competitive understorey species to changing environmental conditions. In this endeavour, space-for-time (SFT) substitution, i.e. using environmental gradients across space to infer responses to environmental change over time, can be valuable when temporal data are unavailable. Here, we capitalise on the existence of 36 individual survey-resurvey studies from forests across temperate Europe to assess how six competitive understorey plant species respond to large gradients of overstorey cover, soil conditions, atmospheric N deposition and climatic conditions over space and time. Given we have data from historical and contemporary surveys, we can (i) test if observed contemporary patterns across space are consistent at the time of the historical survey, and, crucially, (ii) assess whether changes in abundance over time given recorded environmental change match expectations from patterns recorded along environmental gradients in space. We found consistent spatial relationships at the two periods: local variation in soil variables and overstorey cover were the best predictors of individual species' cover while interregional variation in large-scale variables, i.e. N deposition and climate, was less important. However, we found that our SFT approach could not accurately explain the large variation in abundance changes over time. We thus recommend to be cautious when using SFT substitution to infer species responses to temporal changes.