Trait-based assembly rules across climatic gradients of European grasslands

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Background & Aims: Trait-based studies of species assembly can reveal mechanisms of species coexistence. European grasslands support a rich flora with high small-scale species density, mirroring intricate coexistence mechanisms. These mechanisms might show differences related to climate, soil conditions and disturbance history of a site. We compare assembly rules across European grasslands differing in climate, soil and land use history.

Study sites: We investigated fine-scale patterns of trait-based community assembly in European grasslands across continental gradients within the framework of the BiodivERsA project SIGNAL. The gradient extends from the mesic grasslands in France and Germany (mean annual precipitation/MAP: 750–1200 mm; mean annual temperature/MAT: 8° C to 7° C, resp.), to intermediate ones in Italy and Bulgaria (MAP: 880–560 mm; MAT: 12.1° C to 10.2° C, resp.), to xeric ones in Turkey and Hungary (MAP: 715–550 mm; MAT: 16.7° C to 10.5° C, resp.). The sites also differ in management, disturbance history, geology and edaphic factors. They represent common types of grasslands of the respective study country.

Methods: Fine-scale patterns of species combinations (rooting individuals) were sampled in 2.80 m X 0.40 m blocks, subdivided into 448 micro-quadrats of 25 cm^2 (5 cm X 5 cm). To account for within site heterogeneity, six blocks were sampled at each site. Specific leaf area (SLA), plant height and seed mass were assessed, using literature sources and direct measurements, for all recorded vascular herbaceous species. Based on these traits, Rao's functional diversity was calculated for each micro-quadrat and compared to a null model. We used Schamp's method for randomization: keeping the abundances of species and the local species richness as in the field and assigning traits at random to each species combination. Deviation of functional diversity from random expectation was interpreted as trait divergence or trait convergence.

Main Results & Interpretations: Several occurrences of trait-based assembly rules could be detected across countries. The strongest deviations from randomness in terms of seed mass were found in the Turkish grassland (driest one). In Bulgaria, Hungary, France and Germany, by contrast, we detected convergence of seed mass. Strong convergence of plant height appeared in tall mesic grasslands of Germany and France, while this trait showed random pattern in dry grasslands. The Turkish grassland showed convergence for SLA. Similar tendency occurred at the German and the Italian sites while those of France and Bulgaria mostly showed random patterns. Italian grasslands (spatially very close) showed both convergence and divergence of seed mass indicating heterogeneous environmental conditions and/or complex site history. We conclude that assembly rules can be contrasting and context dependent at different grassland sites and climatic differences are often masked by local factors such as disturbance regime or soil heterogeneity.

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