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Community ^{15}N isoscapes to resolve plant-plant-interactions at the spatial scale

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Isoscapes have greatly improved our ability to understand biogeochemical processes on continental to global scales. However, the isoscapes framework may also have significant potential to resolve the spatial component of within-community interactions. For example, exotic plant invaders often exert strong impacts on ecosystem functioning, particularly regarding water-, carbon- and nutrient-cycles, but the spatial extent of such alterations is largely unknown. Here we show that massive N input by the N_2-fixing exotic invasive *Acacia longifolia* to a Portuguese dune system can be traced using spatially resolved information on native plants' leaf δ^{15}N. We found isotopic signatures of N to differ strongly between the native system (δ^{15}N c. -10 ‰) and the atmospherically derived N in *A. longifolia* phyllodes (δ^{15}N c. 0 ‰). Thus, sources of N for native plants could be readily distinguished. Leaf δ^{15}N of a native, non-fixing species was increasingly enriched the closer the plant grew to the invader, indicating uptake of fixed N provided by *A. longifolia*. The enrichment was evident far beyond the stands of the invader, demonstrating that *A. longifolia* affected N budgets of native species up to a distance of 8 m exceeding the margin of the canopy. Furthermore, using the isoscapes approach, we were able to quantify the total area of N enrichment and could thus show that the area affected by invasion was at least 3.5 times larger than the area actually occupied by the invader. However, a native N_2-fixing species had no such effects.
Thus, downscaling isoscapes to the community level opens new frontiers in quantifying the spatial dimension of functional changes associated with plant invasions. Moreover, considering the feasibility and applicability of this approach, it may provide a promising tool to identify, quantify and monitor different types of functional plant-plant interactions within communities at a spatially explicit scale.