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Plant trait response to livestock grazing across habitats and years in a semi-arid African savanna

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Introduction: Exploring the relation between species traits and the environment facilitates general statements beyond taxonomic levels about the response of organisms to environmental constraints. Traits are necessary generalisations to build predictive models of the response of ecological communities to environmental changes. In a semi-arid African savanna we tested the responsiveness of a choice of different whole-plant, leaf and regenerative traits to livestock grazing. As naturally occurring grazing gradients we used piospheres, i.e. zones of animal impact around livestock watering points.
Methods: At a regional scale, vegetation composition, environmental parameters and plant traits were sampled within piospheres, on differently managed farms in different habitat types and two different years. To separate the influence of grazing from other environmental variation caused by, e.g. different habitat types we applied a partial direct approach to analyse the trait-environment relation, called partial RLQ. RLQ is an ordination technique (Dolédec et al. 1996) relating a matrix of environmental variables by samples to a species-by-traits matrix using a species-abundance-by-samples matrix as a link. To test the relation between single traits and environmental variables we applied the fourth corner statistic (Dray & Legendre 2008).
Results: The partial approach removed confounding environmental variation caused by the sampling in different habitats and years. As result, grazing related environmental variables like distance from water point, dung cover, soil pH and conductivity were the most influential regarding the trait distribution along the RLQ axes. Long leaves, belowground clonality, perennial life cycle, anemochory, leafy stems and entire leave blades showed a significant negative relation to increased grazing pressure. The traits prostrate-creeping habit, compound leaves, herbaceous growth form, annual life cycle, no clonality, high specific leaf area (SLA) and zoochory were positively associated with high grazing pressure.
Conclusions: Our results indicate that even at a regional level the analysis of the relation of plant traits to a certain ecological driver like livestock grazing can be confounded by local environmental variation like, e.g. soil condition. For trait analyses on a large spatial scale we would therefore recommend a step including the partialling out of confounding environmental variation. Traits responding negatively or positively to grazing pressure are to a large extent consistent with those grazing response traits found in other studies and could be related to life history, growth and regeneration.

References:

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