Grazing exclusion effects on vegetation structure and soil organic matter in savannas of Río de la Plata grasslands

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Journal of Vegetation Science, 2024, 35, e13304

DOI: https://doi.org/10.1111/jvs.13304

Abstract

Questions: Herbivores change plant communities and biogeochemical cycles by changing species composition and soil organic matter contents through different mechanisms. Our objective was to evaluate the effects of livestock removal on plant species composition and soil organic matter stocks in savannas of the Río de la Plata grasslands. Locations: A subtropical savanna in Río Negro, Uruguay. Methods: The experiment consisted of a paired grazing exclusion randomized block design with five sites, where livestock was excluded for 29 years. We recorded differences in plant species composition in different strata and extracted soil cores to analyze soil carbon and nitrogen stocks, and δ13 carbon contents in two different soil organic matter fractions. Results: Long-term livestock removal reduced plant species richness and diversity, altered the floristic composition and facilitated native-shrub encroachment. Grazing exclusion modified the relative frequency of plant functional types and reduced summer-growing grasses. We recorded 45 species common to both grazing and exclosure treatments, while 19 were present only in exclosure sites and 39 only in grazed sites. Livestock exclusion had a differential effect on soil organic matter formation, increased soil organic carbon and nitrogen stocks in the mineral-associated organic matter (MAOM) but tended to slightly reduce them in the particulate organic matter fraction (POM). Grazing removal modified the C3/C4 species cover and these differences were reflected in the δ 13C contents of both POM and MAOM fractions. Conclusions: Removal of domestic herbivores increased shrub abundance, decreased plant species richness and diversity but increased total carbon and nitrogen contents in soil organic matter. Our results suggest that grazed and exclosure areas should be combined mosaically in the landscape to maximize plant species diversity and soil organic carbon sequestration.