

Long term grazing impact on soil carbon and nitrogen pools in South American grasslands

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ABSTRACT:

Grazing by domestic herbivores at high stocking rates, can alter the structure and function of natural grasslands. Early studies had not detected clear effects of grazing on soil organic carbon (SOC). However, recent northern-hemisphere long term experiments, suggest that SOC increases in the upper 5-7 cm under grazing. We evaluated the effects of grazing on the “Rio de la Plata” grasslands of South America using CENTURY, a process based biogeochemical model and field experiments. Contrary to prior studies, our ecosystem level simulations of grazing impacts showed a reduction in SOC associated with a more open and leaky nitrogen cycle that constrains long term organic matter formation. The regional estimates of SOC losses where 0.46 Pg after 400 years of grazing (since introduction of cattle by European’s in the region to the present), less than 10% of global annual emissions from fossil fuels. To evaluate these results, we selected 7 grazing-exclosure sites in the “Rio de la Plata” grasslands of Uruguay. We sampled soil and roots and measured carbon and nitrogen contents at six depths in two different soil size fractions: the particulate organic matter (POM) of rapid turnover and the mineral associated organic matter (MAOM) of low turnover. As CENTURY simulations, our field results showed that grazing reduces total SOC in the upper 30 cm. Grazing also altered the vertical distribution of POM, increasing this labile SOC fraction towards the surface and decreasing it by 30% at 10-30 cm. Such changes had not been evident in previous studies because of the lack of fractionating the SOC pools and the presence of large MAOM fractions in grasslands. The higher root contents (and belowground C inputs) measured at the surface in the grazed areas could be explaining the simultaneously raise of surface POM and decrease of deeper POM.