Root biomass and productivity in a grazing ecosystem: the serengeti

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Abstract
Does grazing by large wild mammals, an intense form of aboveground herbivory, influence belowground productivity? The vast majority of literature data concentrate on short-term pot studies and indicate that clipping consistently retards root growth. Field studies are few and contradictory, but tend to indicate that grazing has little effect on grassland belowground production. We sampled root-soil cores at 0–10 and 10–20 cm increments, at 11 locations across the Serengeti ecosystem, on 10 dates over an annual cycle, sampling monthly during the rainy and early dry seasons and every 2 mo during peak dry season. Fenced and unfenced plots were replicated (n = 2 or 3) at each location. Live roots, identified visually by brightness and texture, were sorted, washed, dried, and weighed. In addition, profiles were sampled at 10-cm increments to 50 cm in fenced and unfenced plots in short, mid-height, and tall grasslands, representing a gradient of grazing, during the month of peak root biomass. Exclosures erected 22–25 yr previously were similarly sampled in short and tall grasslands to a 30-cm depth.
Root biomass reached a pronounced minimum in mid-wet season (February) and a decided maximum at the beginning of the dry season (June). Net productivity, based on maximum–minimum biomass, ranged from 100 to 600 $g \cdot m^{-2} \cdot yr^{-1}$ to a 20-cm depth, with minima ranging from 40 to 150 g/m^2 and maxima from 230 to 700 g/m^2, according to location. There was no evidence that grazing reduced root productivity over the annual cycle. Vertical biomass profiles at peak standing crop were similar for short, mid-height, and tall grasslands, with root biomass dropping sharply with depth, except for short grasslands on soils that, atypically, lack a hardpan. In those grasslands, shallow root biomass was lower than in other grasslands, but biomass at depth was distinctly greater. For long-term protected grasslands, root biomasses at peak were identical in short grasslands, whether fenced or unfenced, but fenced tall grasslands had a lower root biomass than grazed plots. We conclude that intense herbivory does not inhibit root biomass or belowground productivity of Serengeti grasslands over either the short or the long term.