

Effects of grazing pattern and nitrogen availability on primary productivity.

María Semmartin and Martín Oesterheld

Abstract.

A major part of the impact of grazing on primary productivity results from the joint action of tissue removal and nutrient return to the soil via dung and urine. Grazing, however, is not uniformly distributed in space: grazed grasslands show a matrix of grazed and ungrazed patches, which in turn, may or may not be affected by faecal or urine deposition. This paper investigates the effects of grazing spatial pattern and nitrogen availability on primary productivity. We propose that grazed plants located at the edge of a grazed patch are more shaded by their taller ungrazed neighbours than plants at the center. Since the border effect is less important as patch size increases, the effects of grazing will be more positive, or less negative, when grazing pattern is coarse-grained than when it is fine-grained. We also propose that nitrogen availability will affect this response to grazing through its effects on the intensity of competition for light and on the amount of compensatory growth. We performed a field experiment in a grassland community of the Flooding Pampa, Argentina, in which we compared the productivity of undefoliated controls and defoliated patches of different size, with and without nitrogen application. Defoliation reduced primary productivity and this effect was greater in the smallest, fertilized patches. Productivity was highest at patches of intermediate and large sizes. Nitrogen addition increased productivity by two-fold. The integrated photon flux density reaching the base of the canopy was affected by defoliation and by patch size: it was lower in controls than in defoliated patches and increased with patch size. Our results showed that (a) the size of the defoliated patch modified the response of this grassland to defoliation, (b) this response was correlated with light availability, and (c) nitrogen addition, simulating urine depositions, increased primary productivity and affected the response to defoliation of the smallest patches.

Key words. Flooding Pampa - Herbivory - Relative growth rate - Spatial pattern - Nitrogen