Long-Time Effects of Grazing on Patagonian Rangelands (Argentina)

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Introduction Rangelands in the area of the Magellan Strait, southern Patagonia, are dominated by tussock grasslands of Festuca gracillima. The Open Tussock Grassland State seems stable, and may endure grazing with little physiognomic changes, but at some step irreversible transitions to dwarf-shrub steppes of Nardophyllum brioides take place.

Materials and methods A tussock grassland (Moy Aike Chico, Santa Cruz, 170 mm rainfall) was subjected to 11 years of controlled grazing in an experiment with two 40-ha paddocks at stocking rates of 0.60 (high), 0.20 ewes/ha/year (moderate) and a 2 ha exclosure (equivalent to 1.56 AUM ha-1, 0.50 AUM ha-1 and 0 AUM ha-1) starting in 1987. In 1999, fences were removed and the area returned to normal production grazing regime (0.50 ewes/ha). Six 400 m-2 monitoring plots were established per treatement, and three of them were randomly selected to be fenced off. Vegetation and soil differences between these areas were monitored in years 2000, 2002 and 2006. Vegetation was sampled with point-intercept method (500 points), and composite samples of topsoil (10 cm) were drawn for physical and chemical analysis. One-way Analysis of Variance and Duncan contrasts were performed. Letters in Results section indicate significant differences for treatments in 2006 ($P<0.05$).

Results and discussion Most grazing effects generated in the 1987-1999 stocking treatment persisted after seven years of uniform treatments. Grazed and ungrazed plots in the 1999-2007 period did not differ significantly, so the results are reported jointly. Significant differences were still observed in 2006 in percentage of Bare Soil (30.9a high stocking, 24.2b moderate and 21.3b in exclosure), Litter (13.6b, 16.1b and 22.1a respectively), Short Grasses (16.2b, 23.4a and 22.6a), Dwarf Shrubs (21.3a, 16.8ab and 12.6b) and Shannon-Wiener diversity index (-1.33b, -1.47a, and-1.39ab). Cover of dominant tussock grasses and herbs were not significantly different in 1999. Soils in the grazed treatments still showed in 2006 lower percentages of fine particles such as Clay (13.1a, 11.2b and 10.3b), Fine Silt (13.5b, 14.2ab and 15.3a), Coarse Silt (5.4c, 7.8b and 10.6a) and Very Fine Sand (15.0b, 17.4a, 17.6a), but were enriched in coarse particles including Fine Sand (25.3a, 25.4a and 23.2b), Medium Sand (16.9a, 14.8b and 14.8b), Coarse sand (7.9a, 6.4b and 6.4b), and Very Coarse Sand (3.0a, 2.9a and 1.8b). The lower levels of organic carbon in grazed treatments that were evident in 2000 no longer differed significantly in 2006 (1.47, 1.46 and 1.60%), but significantly different contents of Total Nitrogen (0.14b, 0.15b and 0.17a) and P (15.5b, 24.2a and 18.7b) were observed.

Conclusions The 11 year period of high stocking rates did not generate physiognomic changes in the Magellanic steppes, as these systems seem to persist in Stable States (Oliva et al., 1998), but subtle effects such as a reduction in palatable grass cover and diversity, the increase in dwarf shrubs, reduced soil fertility (N and P) and coarser soil textures (probably because intense winds eroded fine particles away from unstable grazed soil surface) were evident after 7 years, regardless of the grazing management in the recovery period. The results indicate the importance of gradual processes with long-lasting and cumulative effects on vegetation and soil of these perennial-dominated tussock grasslands, and underline the importance of careful long-time management in order to assure sustainable sheep grazing.

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