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The influence of grazing intensity on soil properties and degradation processes in Mediterranean rangelands (Extremadura, SW Spain)

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Rangelands cover vast extensions of land in Spain (>90,000 km2), where a total amount of 13 millions of domestic animals graze extensively their pastures. By clear-cutting shrubs, removing selected trees and by cultivation, these rangelands were created from former Mediterranean oak forests, mainly composed by holm oak and cork oak (Quercus ilex rotundifolia and Q. suber) as tree species, Nowadays this land system is exploited economically in large farms (>100 ha), most of them held on private ownership (80% of total) and dedicated to extensive ranching. Overgrazing is common and the excessive stocking rates may deteriorate soil quality, causing economic losses and environmental damage. Many studies have been developed on the effects of livestock grazing over soil properties and degradation processes, most of them by only comparing extreme cases (e.g. ungrazed vs. grazed or overgrazed areas). The main goal of this study is to contribute to the understanding on how animal grazing affects soil properties and degradation processes. The study is particularly focused on soil compaction and sheet erosion as related to the reduction of vegetation cover by defoliation.

Soil properties were analysed from 119 environmental units selected from 56 farms distributed throughout the region of Extremadura (SW Spain). The units are representative of different rangeland types, i.e. scrublands of Retama sphaerocarpa, dehesas (wooded rangelands) and treeless grasslands. Soil surface cover was determined along transects in September 2010 (antecedent rainfall: 413-923 mm) considering the following classes: bare ground, grasses, mosses, litter, stones (<2 mm) and rock outcrops. Farmer interviews were also conducted in order to quantify stocking rates and to assess land management in 12 out of 56 farms. In the farms where transects and farmer interviews could not be carried out, bare soil surface and livestock densities were estimated. Bare soil surface was determined by classifying aerial orthophotographs (summertime) and animal stocking rates were deduced from the relationship found between livestock density and bare soil as quantified on 21 of the study units. On the basis of this relationship, bare soil surface increases linearly up to a livestock density of 1.80 LU ha-1. From that value bare soil increases following a hyperbolic equation up to 15.76 LU ha-1.

No significant relationships were found between livestock density and cations, nutrients and soil organic matter content. Regarding degradation processes, besides the abovementioned relation with bare soil surface, a significant positive relation was found between livestock density and bulk density for samples taken from 3 to 10 cm depth. This relation was not observed for the samples taken from the upper soil layer (0-5 cm). Results show that increasing stocking rates leads to the reduction of vegetation cover and, as a consequence, to water erosion and subsoil compaction in the short term. Further research is necessary in order to improve our understanding about how livestock grazing affects soil properties in the long term. A validation of the proposed methodology in other farms is also needed.