Patterns of land use and ownership and their influence on pasture quality in the mountains of northern Spain

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Abstract
The extensive livestock systems of a mountain valley were defined integrating spatial information on the vegetation of pastoral value, land ownership (common and private) and livestock use (grazing and mowing). The results reflect the importance of common pastures, constituting half of the total forage production and hosting the major plant communities of high environmental value. However, the prevalence of shrub communities with low pastoral value, and the significant presence of Senecio jacobaea and Pteridium aquilinum, reflecting processes of degradation, undermines the productive capacity of the resource. In privately owned grasslands, high productivity and intensive use found close to the villages contrasts with the degradation processes caused by reduction of use observed in less-accessible areas.

Keywords: common land, extensive livestock farming, abandonment, grazing, mowing, burning.

Introduction
Extensive livestock farming has traditionally been the main activity modelling mountain landscapes of northern Spain by means of a local transhumance involving private and common lands. In the last few decades noticeable changes in these systems (Puente, 2002) have frequently produced land degradation with serious ecological and socioeconomic repercussions (Busqué et al., 2006). In this paper we quantify the current productive and ecological value of the forage resources of a representative mountain valley of this region. We relate these to patterns of land use and ownership, identify recent changes and suggest some ideas to be addressed for the future planning of livestock farming in our mountains.

Materials and methods
The Tudanca valley, with an area of 5240 hectares, is located in the European Atlantic biogeographical region. Its climate is characterized by average annual temperatures of 12ºC and annual rainfall above 1000 mm, without significant dry periods. Its strong altitudinal gradient, between 300 and 1500 m a.s.l, combined with a varied geology, with the presence of Jurassic limestones alternating with sandstones and conglomerates of the Lower Cretaceous, define a complex mountain landscape with heterogeneous plant productivity. Beef cattle and horses for meat production are the main economic activities, with a total of 27 farms that concentrate 806 cows and 306 horses.

The spatial distribution of three variables of livestock interest has been analyzed using a Geographic Information System (GIS): vegetation (type, productivity and environmental value), livestock use (mowing and grazing) and land ownership (private and common). From the definition of 43 plant functional types, a vegetation map at a scale of 1:20000 was produced using photo interpretation and a recent national land-use cartography (SIOSE, 2005), resulting in 161 homogeneous units. The cover of functional types in each unit was visually estimated in the field and subsequently aggregated in nine types of herbaceous and
five types of shrub plant communities (Figure 1). An average annual productivity was assigned to each community using various sources (Busqué et al., 2006; Fillat et al., 2008), with values ranging from 1000 to 5000 kg DM ha\(^{-1}\) yr\(^{-1}\). Habitat conservation value was evaluated depending on their inclusion in Council Directive 92/43/EEC. Types of ownership were obtained from the Land Registry, while the main livestock use was verified in the field.

**Results and discussion**

![Diagram](image)

Figure 1. Models and area occupied by the pasture vegetation of the commons (a) and private land (b) as affected by the gradients of soil acidification, livestock use and fire intensification. Arrows indicate the most frequent changes. Communities in bold are shrub dominated and those between brackets are located at higher altitudes.

Common pastures represent 85% of the total area eligible for livestock use (Figure 1a). Most are shrub communities (76%) of low forage value, indicating the low current importance of the Commons as pastoral land. Of these, more than half is occupied by heath species (*Erica* spp.) on degraded soils favoured by inappropriate use of burning and the strong decline in the
numbers of sheep, goats and cattle of local breeds with high browsing capacity (Osoro et al., 1998). However, from the environmental point of view, these heath communities are priority habitats at European level, mainly due to their scarcity in North Atlantic Europe. The rest of the shrub communities, resulting mainly from recent abandonment of grazing, maintain good soil productive capacity and are easily reversible to grasslands or other forestry uses. One quarter of the grasslands in the commons are hay meadows that are harvested once annually in late summer by all the farmers after mowing their private plots. Late harvests, absence of fertilization, limestone substrate and grazing in spring and autumn, result in the dominance of a grassland community rich in forbs (Arrhenatherion bulbosi), with high biodiversity, but regionally becoming rare due to land use changes (Fillat et al., 2008). The rest of the grassland area is shared equally between the most productive and fertilized (Cynosurion cristati), and those of moderately productive but higher environmental value, both on limestone (Mesobromenion and Potentillo-Brachypodenion) and on acid substrate (Violion caninae). The colonization of certain plant species in some areas indicates degradation processes caused by inappropriate management. Senecio jacobaea in Mesobromenion grasslands reflect an intense and out of season grazing, while the predominance of Pteridium aquilinum or Brachypodium pinnatum is due to the abandonment of pastoral use in previously productive grasslands (Fillat et al., 2008).

In private grasslands (Figure 1b), the maintenance of the highly productive meadows close to the villages (mown Cynosurion) contrasts with the different degrees of abandonment in the management of the more remote and less accessible properties (35% of the total area). The transformation from mown to grazed-only grasslands is producing two degradation processes: the colonization by P. aquilinum or B. pinnatum and the deterioration of an important cultural heritage, stone walls and stone and wooden buildings for animal shelter and hay storage (Corbera, 2010).

Conclusions

At the valley scale, forage production is similar in the commons and in the private land, reflecting that the community resources are still important for the current farming systems. Most of the feed requirements of the existing livestock in the valley could in theory be supported by the forage produced internally. Our current research is focused on the analysis of the management bottlenecks that hinder the achievement of this goal. We think there is an urgent need to develop participatory management plans and to redesign the current subsidy schemes in order to prioritize the production of quality livestock goods based on the sustainable use and improvement of local resources.

References

SIOSE (2005) CNIG, Gobierno de España, www.siose.es