Changes in mountain landscape and livestock management in northern Spain: a study in Las Ubiñas-La Mesa Biosphere Reserve (Asturias, NW Spain)

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Changes in mountain landscape and livestock management in northern Spain: a study in Las Ubiñas-La Mesa Biosphere Reserve (Asturias, NW Spain)

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Abstract. Asturias is a region with outstanding biodiversity frequently linked to mountainous areas where traditional activities (mostly animal husbandry) have shaped and maintained diverse landscapes. Such areas have evolved significantly over the past decades, although our knowledge of the past and present dynamics is clearly limited despite it would be essential for their future management. In addition, the diversity of ecosystems, environmental and socio-cultural conditions present in the Asturian territory demand both global and local approaches. The aim of this study was to analyze the evolution of the landscape in a pastoral area (Puertos de Agüeria) included in Las Ubiñas-La Mesa Biosphere Reserve, a protected area where seasonal transhumance of beef cattle and horses persists, whereas other livestock species (especially small ruminants) have disappeared. The orthorectification and photointerpretation of aerial photographs provided the database for the study of landscape evolution. The changes in landscape were evaluated qualitatively and quantitatively using aerial images from 1956, 1985 and 2011. A progressive impoverishment of the mosaicity is observed together with a structural homogenization. The role of small ruminants in shaping the landscape is discussed. The shrublands and forests increased while grassland areas substantially decreased. Such changes are related to shifts in livestock composition: a progressive disappearance of sheep and goats towards a dominance of cattle and horses.

Keywords. Landscape ecology – GIS – Aerial photographs – Livestock management – Mountain pastures.

Changements dans le paysage de montagne et de la gestion de l'élevage dans le nord de l'Espagne: une étude dans la Réserve de Biosphère Las Ubiñas-La Mesa (Asturies, NW Espagne)

Résumé. *Les Asturies est une région avec une biodiversité exceptionnelle, fréquemment liée à des zones montagneuses avec des activités traditionnelles (principalement animaux de pâturage) qui ont façonné et préservé des paysages variés. Ces zones ont considérablement évolué au cours des dernières décennies, bien que notre connaissance des dynamiques passées et présentes est clairement limitée, elle continue à être essentielle pour leur gestion future. La diversité des écosystèmes, l'environnement et les conditions socio-culturelles présentes demande des approches globales et locales. Le but de cette étude était d'analyser l'évolution du paysage dans une zone pastorale (Puertos de Agüeria) inclue dans la Réserve de Biosphère Las Ubiñas-La Mesa, une zone où la transhumance saisonnière des bovins de boucherie et les chevaux persiste, alors que d'autres espèces de bétail (en particulier les petits ruminants) ont disparu. L'orthorectification et la photo-interprétation de photographies aériennes nous a fourni la base de données pour l'étude de l'évolution du paysage. Les changements dans le paysage ont été évalués qualitativement et quantitativement en utilisant des images aériennes de 1956, 1985 et 2011. Un appauvrissement progressif de la mosaïcité a été observé, avec une homogénéisation structurelle. Le rôle des petits ruminants dans le façonnement du paysage a été analysé. Les zones arbustives et les forêts ont augmenté tandis que les zones de prairies ont considérablement diminué. Ces changements sont liés à des changements dans la composition de l'élevage: une disparition progressive des moutons et des chèvres et une dominance des bovins et des chevaux.*

Mots-clés. *Écologie du paysage – SIG – Photographies aériennes – Gestion du bétail – Alpages.*

I – Introduction

Extensive traditional livestock farming has been the main activity modelling mountain landscapes of northern Spain. In the last few decades drastic changes in these systems such as abandonment, reforestation (Garcia-Ruiz *et al*., 1996) or soil degradation endanger their cultural and ecological values (Rosa García *et al*., 2013) and decrease their landscape quality and attractiveness (Lasanta *et al*., 2011). These processes are occurring in the Cantabrian Mountains (NW Spain), including biologically relevant mosaics of habitats traditionally co-grazed by both the livestock from the local communities plus sheep flocks coming from other areas (Rodríguez, 2004). Our knowledge of the past and present dynamics in these areas is clearly limited despite it would be essential for their future management. The aim of this paper is to analyze the evolution of the landscape linked to traditional livestock systems in mountain regions, taking the Biosphere Reserve of Las Ubiñas-La Mesa as study area, and to investigate the relationships between animal husbandry, environmental and landscape features.

II – Material and methods

The study area covers 450 ha, with altitudes ranging from 1350 to 1800 m, and it is located in Las Ubiñas, a calcareous massif in Cantabrian Mountains. The main plant communities are grasslands dominated by *Festuca rubra*, *Agrostis capillaris* and *Nardus stricta*, dwarf shrublands with heather (*Calluna vulgaris*) and bilberry (*Vaccinium myrtillus*), scrubs with brooms (*Genista florida*), and forests dominated by holly (*Ilex aquifolium*).The area has been used by local communities as summer pastures for extensive mixed flocks since the Neolithic. Transhumance flocks of small ruminants from other provinces also grazed there at least from 1752 (Catastro del Marques de la Ensenada) until 1985 (personal communication).

Data about the number of heads of each livestock species were gathered from both local and regional official databases and documents. Personal interviews with the shepherds who grazed those areas revealed very valuable information about how they used those territories, the grazing periods, areas, strategies, etc.

The analysis of aerial photography provided the database for the study of the evolution of the landscape (Fernández García, 2004). The available series ran from 1956 to 2011. Three years (1956, 1985 and 2011) were selected and scanned. Photographic mosaics were made and images were orthorectified with Agisoft Photo Scan1.1 and Arc Gis 10.1. The patches of vegetation were digitalized with ArcMap 10.1 in a subsequent photo interpretation. The results were validated with field work, interviewing local elderly population and studying old photographs of that landscape for those periods with the method of repeated photography.

III – Results and discussion

1. Changes in livestock censuses

The changes in the structure of the herds grazing in the study area point to a simplification process, concentrating in cattle management and small ruminants virtually disappearing (Fig. 1). Sheep dominated in 1947 thanks to the inputs from transhumance, with typical herds of 1750 Merino sheep and 250 goats (at least from 1752 to 1985). Sheep accounted for 76.8% of total animals (2279 heads of local livestock), goats 12.6%, cattle 10.4% and horses 0.2%. In 1985 the dominance of small ruminants was still evident, with 62.5% sheep and 8.8% goats (for a total of 2850 heads of local livestock). This was the last year of transhumant herds passing to the study area. Cattle and horse numbers started to rise, with 24.6 and 4.2%, respectively, reflecting the farmers' adaptation

to reduced labour after rural exodus began. In 2011, without transhumant herds, cattle accounted for 83% of total animals grazing in the area (646 heads), accompanied by 6.2% horses, 4.6% sheep and 6.2% goats. Such a reduction in small ruminant percentage is largely a consequence of the discriminatory policy of CAP subsidies (Lasanta, 2002), more disadvantageous than for cattle, and the frequent conflicts with predator carnivores.

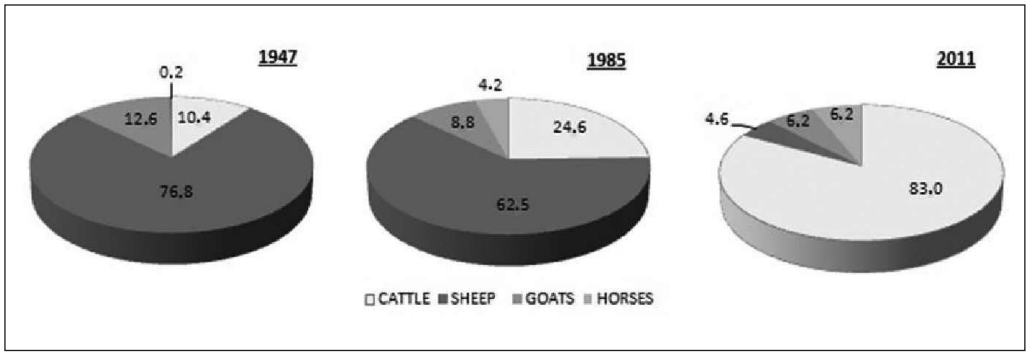

Fig. 1. Percentage of livestock censuses from 1947 to 2011 in the study area.

2. Livestock grazing behaviour and diet selection

Changes in livestock would induce different vegetation dynamics due to their diverse diet preferences and grazing behaviour (Table 1). Cattle and horses are grazers with preference for grasslands (Ferreira *et al*., 2013). They both reject brooms and graze on heather or holly when the availability of grasses decreases at the end of grazing season in late summer. By contrast, sheep and goats have stronger preference for shrubs and steeper slopes (Osoro *et al*., 1999). They both consume broom and holly, but sheep show a higher preference for grasslands than goats (Rosa García *et al*., 2012).

Table 1. Dietary preferences of the main plant components in the study area for each livestock species

Plant communities	Sheep (S)	Goats (G)	Cattle (C)	Horses (H)	Ranking of preferences
Heather (*Calluna vulgaris*)	+/-	+	+/-	+/-	G>S>C>H
Grasslands (*Agrostis-Festuca*)	+	+	+	+	H>C>S>G
Broom (*Genista* spp.)	+	+	-	-	G>S>H>C
Holly (*Ilex aquifolium*)	+	+	+/-	+/-	G>S>C>H

(+) positively selected; (-) rejected; (+/-) eaten when availability of more preferred species is limited.

3. Changes in vegetation cover

A progressive impoverishment of the mosaicity is observed together with a structural homogenization. Both processes did not evolve at a constant speed. The landscape was stable from 1956 to 1985, possibly due to the relative stability of the applied grazing management. Drastic changes appeared after 1985, once Spain became a member of the EU and coinciding with the disappearance of transhumance in the study area.

The cover of holy forests slightly increased from 22.0% in 1956 to 24.5% in 2011, although with significant structural changes, becoming in closer stands. Broom scrublands doubled their surface, from 10.5% to 22.3%, mainly at the expense of grasslands. Dwarf heathlands slightly decreased from 8.1% to 5.4%, primarily due to broom invasion in the most ecologically favourable conditions.

Finally, an important reduction in grasslands cover is observed, from 59.4% to 47.8% (Fig. 2). In around thirty years, the landscape evolved from a matrix of grasslands with scattered and sparse patches of holly and brooms towards a more compact scenario where the matrix of grasslands is not dominant in large areas where it has been replaced by dense patches of holly and brooms. These dynamics result in a gradual closing of the landscape, “fermeture du paysage”.

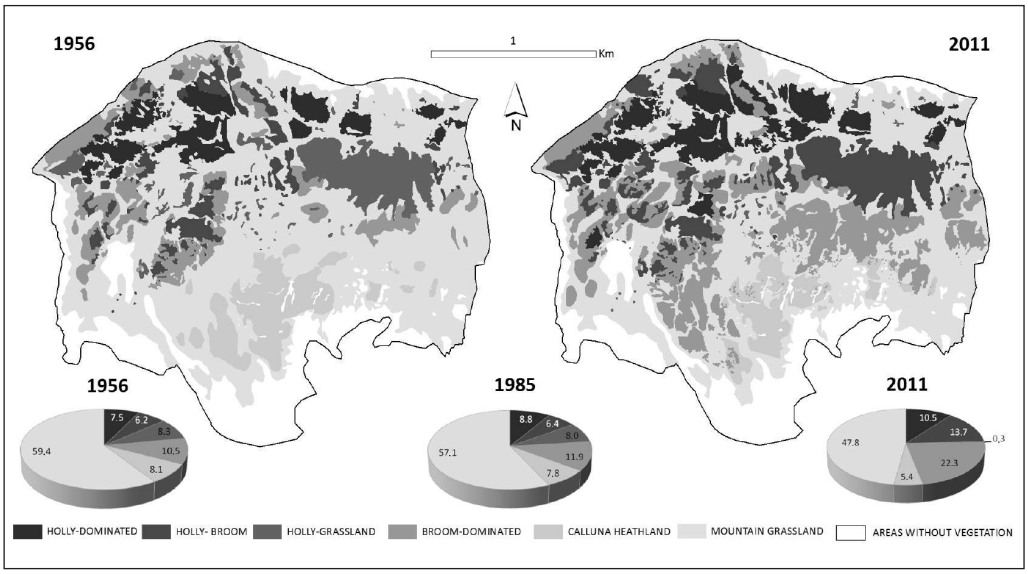

Fig. 2. Changes in vegetation cover from 1956 to 2011 in the study area.

IV – Conclusions

The landscape of the study area is influenced by the existence of an agricultural system of High Natural Value which is under transformation. The combination of livestock grazing behaviour and diet selection and the evolution in the composition of the herds highlight the importance of small ruminants in the maintenance of mountain pastures. Their virtual disappearance concurs with a re-vegetation process which implied proliferation of brooms and densification of holly areas to the detriment of the grasslands. These processes imply a gradual closing of the landscape which could be controlled with prescribed grazing with small ruminants. The study provides relevant data for the management of the protected area and could also contribute to the future Rural Development Programs by recognizing the ecological role of small ruminants in landscape stability.

Acknowledgments

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