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An integrated approach to studying the role of grazing livestock systems in the conservation of rangelands in a protected natural park (Sierra de Guara, Spain)

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Abstract

The ‘Sierra de Guara’ Natural Park (81,491 ha, Huesca, Spain) is a protected Mediterranean mountain area dominated by shrub and forest pastures. Traditional agriculture, mainly extensive grazing systems, has decreased in the last decades; concurrently, invasion of shrub vegetation, landscape changes and higher risk of forest fires have been observed.

A study, which started in 2000, was carried out with two broad objectives: at the farm level, to analyse the farming systems and evaluate management strategies; at the regional level, to give useful information to conservation authorities for better decision-making.

An integrated approach with different spatial scales and methods of analysis was used. First, a survey covering all farms that utilized the Park was carried out and livestock farming systems were characterized in terms of grazing management, technical and socio-economic factors. Second, six representative areas were selected to evaluate, depending on livestock utilization, grass and shrub vegetation dynamics (biomass, green/dead ratio). Third, vegetation and livestock data were analysed using a Geographic Information System to identify constraining factors and areas of intervention. Key imbalances were identified that can threaten the sustainability of the Park: low continuity of farming families; intensification of the management system; degradation of grazing resources; and concentration of grazing areas. A number of management recommendations are raised. © 2005 Elsevier B.V. All rights reserved.

Keywords: Grazing livestock systems; Vegetation dynamics; Rangeland management; Protected areas; GIS

1. Introduction

Mountain and forest pastures have traditionally played an important role in the development of live-

stock production systems in Europe, particularly in Mediterranean areas. Extensive livestock systems are primarily dependent on pastoral resources and grazing farm animals, which can have a great impact on the vegetation (Perevolotsky and Etienne, 1999) not only in terms of productivity and quality but also in terms of vegetation dynamics (Rook and Tallowin, 2003), species and community diversity (Collins et al., 1998;

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Sternberg et al., 2000) and landscape (Hartnett et al., 1996; Adler et al., 2001), where heterogeneous vegetation created a particularly rich landscape mosaic (Balent and Gibon, 1996).

The 'Sierra de Guara' Natural Park (SGNP) (81,491 ha) is located in the Spanish Pyrenees in Aragón, north-east of Spain. It is a typical Mediterranean karstic mountain area, ranging from 430 to 2077 m a.s.l., with great variation in topography, soil and climatic conditions. As a consequence, vegetation is also very diverse, ranging from typical Mediterranean pastures in the lower and southern areas of the Park to Alpine and Atlantic pastures in the more humid and higher areas.

As with many other Mediterranean mountain areas, the Park has suffered a strong decline in farming activity, with the consequent abandonment of pastoral areas that has originated changes in vegetation dynamics (invasion of shrub and forest vegetation) and, therefore, in landscape composition. Concurrently, there is an increasing risk of environmental hazards, of which the most important one is forest fire. A process of substitution of agriculture with other economic activities, mainly tourism, can also be observed.

There is an increasing interest in using and preserving grazing resources, especially those located in protected natural areas. Multifunctionality of grazing systems is widely recognised and, together with production and economic objectives, cultural, social and environmental implications need to be taken into account. In this sense, livestock farming systems based on grazing can be considered as a cost-effective instrument to modulate the strong dynamic of vegetation towards shrub invasion (Montserrat, 2001; Casasús et al., 2003). If adequately implemented, grazing management can be a suitable tool to maintain traditional landscapes in protected areas and prevent forest fires (Pérez, 2002; Kramer et al., 2003). Nevertheless, there are important questions that remain unresolved such as: type of pastures and constraints of use; vegetation change associated with grazing management; type of animal and stocking rate to manage pasture resources; or quantitative advantages that can be expected from using these areas, both in terms of animal performance and environmental benefits.

A systemic way of thinking is necessary to gain a holistic understanding of the phenomena which deter-

mine sustainability of livestock grazing systems (Maxwell and Milne, 1995; Gibon et al., 1999). A wide variety of disciplines are involved: technical aspects referring to management of animals and grazing resources, animal-pasture interactions and vegetation dynamics, but it is also necessary to take into account social, economic and political considerations. Hence, multidisciplinary approaches with a combination of spatial, temporal and bio-technical scales (Flamant et al., 1999) are required when trying to address these topics.

In this paper, an illustration of such an integrated approach is given. At the farm scale, the sheep farming systems located in the Park were characterised from the point of view of their structure and management, with special focus on the utilisation of grazing areas but also considering socio-economic factors. Second, the impact of grazing on the herbaceous and shrub vegetation was analysed in representative areas during 3 years. Finally, at the regional scale, the information obtained in the previous stages was integrated into a Geographic Information System (GIS) to detect constraining factors and areas of intervention in order to facilitate management decisions.

2. Characterization of livestock farming systems and animal performance during grazing

To understand the actual role that grazing farm animals are playing in the management and conservation of pasture resources of the SGNP, it is essential to analyse first the livestock systems at the farm scale.

In this study, data were collected from all sheep and cattle farms ($n=62$) that used grazing areas inside the Park in 2000 (Table 1). A structured questionnaire was designed to collect information on family composition and labour force, herd/flock census and structure, land use, general management, grazing management (calendars, animal types, areas and location), farm changes and attitudes of farmers towards Park regulations.

Multiple Correspondence Analysis (MCA) and Cluster Analysis were carried out to typify farms using indicators about farm size, land use, location of grazing resources in the Park and stocking rate. The results of this characterisation can be found in Bernués et al. (2004); in this Section, the features of the

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