Structural productive and management traits in two Mediterranean large-scale grazing systems

Salis L., Sitzia M., Bagella S., Marrosu M., Roggero P.P.

in

Baumont R. (ed.), Carrère P. (ed.), Jouven M. (ed.), Lombardi G. (ed.), López-Francos A. (ed.), Martin B. (ed.), Peeters A. (ed.), Porqueddu C. (ed.).
Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands

Zaragoza : CIHEAM / INRA / FAO / VetAgro Sup Clermont-Ferrand / Montpellier SupAgro
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 109

2014
pages 729-733

Structural productive and management traits in two Mediterranean large-scale grazing systems

L. Salis[1,*], M. Sitzia[1], S. Bagella[2,4], M. Marrosu[1] and P.P. Roggero[3,4]

[1]AGRIS, Dipartimento per la Ricerca nelle Produzioni Animali Loc. Bonassai
S.S. 291 Sassari-Fertilia, Km. 18.6, Sassari (Italy)
[2]Dipartimento di Scienze Botaniche, Ecologiche e Geologiche,
Università degli studi di Sassari (Italy)
[3]Dipartimento di Scienze Agronomiche e Genetica Vegetale Agraria,
Università degli studi di Sassari, via De Nicola, 07100 Sassari (Italy)
[4]Desertification Research Group – NRD, Università degli studi di Sassari (Italy)
*e-mail: lzsalis@agrisricerca.it

Abstract. The aim of this study was to analyse structural, productive and pasture traits of dairy sheep (DS) and beef cattle (BC) grazing systems of a cork oak silvo-pastoral area located in NE Sardinia. In 2009, farm and flock size, secondary grasslands/crops land, animal feed and production, crop management of three DS and two BC farms were compared. Eleven fenced pastures were assessed for their herbage mass production (Hm), grazing value (GV), species richness and stocking rate (SR). DS and BC showed a low-input management related to the high incidence of secondary grassland (>80% of total land). Feed from pasture grazing, on average, supplied more than 70% of the total animal energy requirements for both DS and BC. Mineral fertilizer was distributed at low rate, only in the cultivated hay and forage crops which are grown on arable land to improve the grassland pasture. DS pasture showed a higher Hm than BC pasture, both in spring and autumn, and a significantly higher level of SR. The vegetation analysis did not reveal differences between DS and BC pasture in terms of GV and species richness that were relatively high. Subterranean-clover was the most relevant species in the secondary grasslands.

Keywords. Beef cattle – Dairy sheep –Grazing system – Grazing value.

Traits structurels, productifs et de gestion dans deux systèmes de pâturage Méditerranéen à grande échelle

Résumé. *L'objectif de cette étude était d'analyser les caractéristiques structurelles, productives et pastorales de systèmes ovins laitiers (DS) et bovins à viande (BC) dans une région exploitant le chêne-liège comme ressource sylvo-pastorale dans le nord-est de la Sardaigne. En 2009, les tailles des fermes et des troupeaux, les prairies secondaires/cultures, les aliments destinés aux animaux, et la gestion des cultures de trois fermes DS et de deux fermes BC ont été comparés. Onze parcelles clôturées ont été analysées pour leur production de biomasse herbagère (Hm), ainsi que pour la qualité du pâturage (GV), leur richesse en espèces et leur chargement (SR). Nous avons observé que DS et BC représentent des systèmes à bas niveau d'intrants liés à l'incidence élevée des prairies secondaires (> 80% de la surface totale). L'alimentation issue du pâturage a fourni en moyenne plus de 70% des besoins totaux en énergie des animaux pour les deux systèmes DS et BC. L'engrais minéral a été utilisé à un taux faible, seulement pour la production de foin et pour les plantes fourragères cultivées sur les terres arables pour améliorer les prairies pâturées. Le système DS a fourni une Hm plus élevée que BC, tant au printemps qu'à l'automne et permis un chargement animal SR. L'analyse de la végétation n'a pas révélé de différences entre DS et BC du point de vue de la GV et de la richesse en espèces qui était relativement élevée. Le trèfle souterrain était l'espèce la plus importante dans les prairies secondaires.*

Mots-clés. *Bovins à viande – Ovins laitiers – Système de pâturage – Qualité du pâturage.*

I – Introduction

Mediterranean Large-Scale Grazing Systems provide ecosystem services such as forage and animal productions and high levels of biodiversity (Caballero *et al.*, 2009; Kumar P., 2010). In Sardinia, dairy sheep and beef cattle are the most widespread grazing systems. The former include 44% of Italian herd and around 58% of national sheep milk production (Idda *et al.*, 2010) and represents the most important item in Sardinia agricultural budget. Beef cattle traditional farms are dominant in marginal areas where suckler cattle and their calves are bred for meat production (Sitzia *et al.*, 2012). In both systems farms are characterized by relatively small size that constraints their economic competitiveness (Salis, 2011). Rainfed pastures are represented by secondary grasslands that are maintained through recurrent cultivation of hay and forage crops or shrub chaining and fertilization. They represent the main animal feed source but supplements (mainly hay and concentrate) are supplied to livestock in winter, summer and autumn. A vegetation survey performed on a typical cork oak silvo-pastoral system in NE Sardinia, revealed a relatively high level of plant biodiversity and that livestock management practices influenced plant assemblage composition directly and indirectly via their long-term effects on soil features (Bagella *et al.*, 2013). Moreover, grassland tillage did not affect soil characteristics and pasture production (Salis *et al.* 2011).

This study aims to compare the structural, productive and management traits of DS and BC grazing systems in a Long term observatory located in NE Sardinia (Bagella *et al.*, 2013).

II – Materials and methods

The study was performed in 2009, in a cork-oak silvo-pastoral system characterized by acid soils on a granitic substratum and by mesothermal-subhumid climate (Arrigoni, 2006). Average annual precipitation is 632 mm and mean annual temperature is 14.2°C (data ARPA, Dipartimento Specialistico Regionale Meteoclimatico). A survey was conducted on three dairy sheep (DS) and two beef cattle (BC) farms through structured questionnaires about farm and flock size, secondary grasslands/crops land width, milk and meat productions, crop management, animal feed. Energy requirements (ER) of herd expressed as daily milk feed unit (UFL head^{-1} day^{-1}) were recorded at monthly intervals considering animal maintenance, grazing and productions requirements (Jarrige, 1989; Rossi *et al.*, 1985). The energy supplements was calculated considering the total amount of hay and concentrated fed to the animals and their energy content in UFL (Jarrige, 1989). The energy derived from the pasture was calculated by difference between the energy requirements of herd and the offered supplements.

Eleven representative fenced pastures, seven in DS and four in BC farms were surveyed. In each field three grazing exclosure cages (20 m^2) were randomly positioned to measure monthly ungrazed herbage mass production (Hm) on sampling areas of 0.5 m^2 in size. Fresh forage was dried in an oven-dryer at temperature of 65°C to evaluate the dry matter production (DM, t ha^{-1}). Vegetation surveys were performed in spring to assess the specific contribution of each plant species in pasture, richness and grazing value (GV) (Daget and Poissonet, 1971). The average annual stocking rate (SR), expressed as livestock units (LU ha^{-1}) was also calculated for each surveyed field. Hm, GV and SR data were analysed using the GLM ANOVA procedure of the SAS software (SAS, 2002).

III – Results and discussion

In 2009 rainfall and mean annual temperature were slightly higher than long terms values (739 mm and 15.7°C). DS had greater farm and flock size than BC and land use of both systems was characterized by the dominance of secondary grasslands: 81 and 88% (whereas forage/hay crops were 19 and 12%) of total land in DS and BC respectively (Table 1). The DS farms aver-

age milk production was 40.5 t y^{-1}, 2.8 t y^{-1} of meat (lambs), less than BC farms that produced 4.8 t y^{-1} of meat (calves). All farmers adopted similar extensive agronomic management. Tillage for hay and forage-crop cultivation was made through disc ploughing (20-30 cm in depth) and harrowing. Seeding was performed with a fertiliser spreader, followed by light harrowing to cover the seed. Mineral fertilizers were distributed at a mean rate of 30 and 14 kg ha^{-1} of N and 77 and 35 kg ha^{-1} of P_2O_5 in DS and BC respectively. Annual animal ER ranged from 1.1 to 6.6 UFL $head^{-1}d^{-1}$ in DS and BC farms respectively. On both DS and BC grazing systems, the secondary grasslands and forage crops were the main source of animal feed.

The BC feeding system was based on a higher proportion on pasture grazing that covered 83% of the animal ER, as the average over the year, and 100% in May and June (Fig. 1). During summer, the calves were supplemented with little amount of concentrate and hay covered the energy gap of the available pasture.

In the DS farms, 73% of herd ER were covered by pasture grazing, with highest proportion observed in spring. Concentrates were mainly supplied in the winter milking period and in summer and covered on average 17% of the annual animal ER. Hay was given overall in autumn, during the pregnancy period, when covered up to 32% of the animal ER.

Table 1. Structural traits and livestock productions (mean ± SE) in the two grazing systems in 2009

Grazing system	Farm size (ha)	Secondary grassland (%)	Flock size (n)	Milk production (t. $year^{-1}$)	Meat production (t. $year^{-1}$)
DS	71 ± 15	81 ± 8	293 ± 13	40.5 ± 4.7	2.8 ± 0.6
BC	48 ± 3	88 ± 10	38 ± 3	–	4.8 ± 0.3

DS = Dairy sheep; BC = Beef cattle.

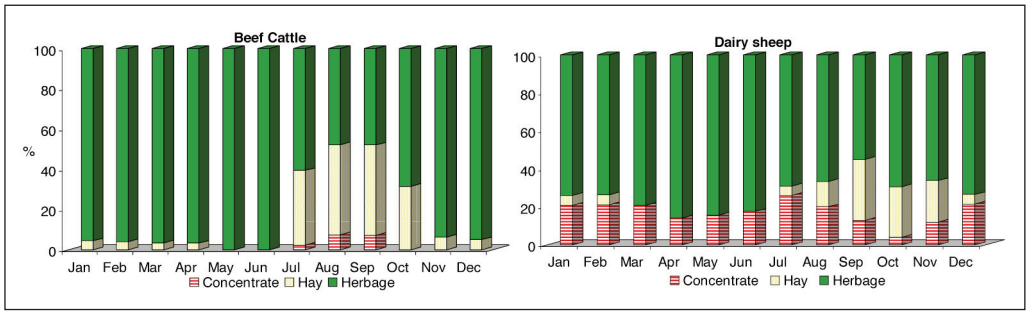

Fig. 1. Relative energy intake (%) from the concentrate, hay and herbage for the beef cattle and dairy sheep farms.

Herbage production showed a typical Mediterranean pattern with the highest herbage mass produced in spring (Table 2). DS pastures showed a significant higher Hm than BC in spring and autumn and a significantly higher SR (2.0 vs 0.6 LU ha^{-1}, $P<0.01$). BC pastures were continuously stocked whereas DS pastures were rotationally grazed.

The vegetation analysis did not reveal differences between DS and BC pastures in terms of GV that showed relatively high values (42.1 and 36.5 in DS and BC respectively). Plant species richness showed similar values in the pastures of the two farming systems, 64 and 61 in DS and BC respectively. *Trifolium subterraneum* was the most abundant species and its specific contribution was on average higher than 10%.

Table 2. Seasonal average and maximum Hm production (t DM ha^{-1}) in the GS

	Spring		Autumn	
GS	**Average**	**Maximum**	**Average**	**Maximum**
DS	1.6	2.8	1.0	1.2
BC	1.1	2.1	0.6	0.7
P†	<0.05	ns	<0.001	<0.01

Hm = Herbage mass; GS = Grazing system; DS = Dairy sheep; BC = Beef cattle.
† LSD test; n.s.= not significant.

IV – Conclusions

The two Mediterranean large-scale grazing systems investigated, DS and BC, showed small size and extensive management. The feeding technique was based principally on secondary grassland grazing and little supplementation of hay and concentrates. Secondary grasslands were the dominant land use in the landscape but few hay and forage crop cultivations are strategic to reduce the external feed inputs. The grazing management was compatible with a relatively high level of plant biodiversity and GV, and it is consistent with the EU recommendations on the maintenance of good agricultural and environmental conditions (Salis, 2011). Further studies on others ecosystem services are being conducted in the long term observatory to assess the potential of carbon sequestration and forestry productions.

Acknowledgements

The authors wish to acknowledge G. Becugna, S. Mastinu and A. Pintore for their collaboration; Dr. Andrea Cabiddu and Dr. Sara Casu for their contribution in the abstract French version.

References

Arrigoni P.V., 2006. *Flora dell'Isola di Sardegna*. Sassari: Carlo Delfino editore. 280 p.

Bagella S., Salis L., Marrosu G. M., Rossetti I., Fanni S., Caria M.C. and Roggero P.P., 2013. Effects of long-term management practices on grassland plant assemblages in Mediterranean cork oak silvo-pastoral systems. In: *Plant Ecology*, 214, p. 621-631.

Caballero R., Fernàndez-Gonzàlez F., Perez Badia R., Molle G., Roggero P.P., Bagella S., D'Ottavio P., Papanastasis V.A., Fotiadis G., Sidiropoulou A. and Ispikoudis I., 2009. Grazing systems and biodiversity in Mediterranean areas: Spain, Italy and Greece. In: *Pastos*, 39, (1), p. 9-53.

Daget P. and Poissonet J., 1971. Une méthode d'analyse phytologique des prairies. Critères d'application. In: *Annales Agronomiques,* 22(1), p. 5-41.

Jarrige R., 1989. *Ruminant nutrition. Recommended allowances & feed tables*. Mountroge: INRA/John Libbey. 471 p.

Kumar P., 2010. *The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations*. London: Earthscan. 456 p.

Idda L., Furesi R. and Pulina P., 2010. L'allevamento ovino in Sardegna. In *Economia dell'allevamento ovino da latte*. Milano: Franco Angeli. p. 53-97.

Rossi G., Tellarini V., Pulina G., Campus F., Brindano P. and Lucifero M., 1985. Contributo alla razionalizzazione dell'allevamento estensivo: organizzazione e dimensionamento del carico di aziende indirizzate verso la produzione di vitelli da ristallo. In *Zootecnia e nutrizione animale*, XI suppl. al n. 5.

Salis L., 2011. Mediterranean grazing systems and plant biodiversity In: *Dissertation*, University of Sassari.

Salis L., Sitzia M., Fanni S., Bagella S., Zanzu N. and Roggero P.P., 2011. Relationships between grassland management, soil and pasture characteristics in Piedmont Mediterranean grazing systems. In *Proc. of the 16th Meeting of the FAO-CIHEAM Mountain Pastures Network*. Krakow, Poland, p. 71-74.

SAS, 2002. SAS 9.0. Institute Inc., Cary, NC, USA.

Sitzia M., Salis L., Marrosu G.M., Acciaro M. and Decandia M., 2012. Sustainability of a beef cattle production system in Mediterranean marginal areas. Proc 14th FAO-CIHEAM meeting Sub-network Mediterranean Pastures and Fodder Crops. Samsun, Turkey. *Options Méditerranéennes, Series A,* 102, p. 395-399.