Pastoral value of mountain pastures of Monti Sibillini (Central Apennines, Italy) grazed by sheep

D'Ottavio P., Scotton M., Ziliotto U.

in

Molina Alcaide E. (ed.), Ben Salem H. (ed.), Biala K. (ed.), Morand-Fehr P. (ed.). Sustainable grazing, nutritional utilization and quality of sheep and goat products

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 67

2005
pages 93-98

Pastoral value of mountain pastures of Monti Sibillini (Central Apennines, Italy) grazed by sheep

P. D'Ottavio*, M. Scotton and U. Ziliotto****
*Dipartimento di Scienze Ambientali e delle Produzioni Vegetali, Università Politecnica delle Marche, Via Brecce Bianche, 60131 Ancona, Italy
**Dipartimento di Agronomia Ambientale e Produzioni Vegetali, Università degli Studi di Padova, Viale dell'Università 16, 35020 Legnaro (Padova), Italy

SUMMARY – To contribute to the sustainability definition of the extensive sheep production systems, traditionally adopted in protected areas of Central Apennines, the work was aimed at assessing the pastoral value of the pastures (1400-2450 m a.s.l) of Monti Sibillini National Park. Eighty-one vegetation surveys were performed during two consecutive summers on an area of about 300 ha. The vegetation data were analysed by means of cluster analysis methods. Based on the Specific Indexes (scale 0-5) of the plants, the Pastoral Value (0-100) of the pastures was calculated, on which the potential stocking rate assessment should be based. The vegetation analysis led to the definition of 12 pasture types characterised by different species composition. *Festuco-Seslerietea*, *Festuco-Brometea*, *Molinio-Arrhenatheretea* and *Nardo-Callunetea* were the most frequent phytosociological classes. The assessment of the pastoral value showed values varying between 18.6 and 35.8 for the *Sesleria nitida*- and *Carex macrolepis*- and for the *Festuca nigrescens*- and *F. circummediterranea*-dominated grasslands respectively.

Keywords: Mountain pastures, pastoral value, stocking rate, sheep.

RESUME – *"Valeur pastorale des pâturages de montagne au Monti Sibillini (Apennin Central, Italie) pâturés par des ovins". Afin de définir la durabilité des systèmes extensifs de production ovine traditionnellement adoptés dans les zones protégées de l'Apennin central, la recherche a comme objectif la détermination de la valeur pastorale des pâturages (1400-2450 m) du Parc National des Monts Sibillini. On a effectué 81 reliefs de la végétation pendant deux étés consécutifs sur une surface d'environ 300 hectares. Les données de la végétation ont été analysées à travers des méthodes de analyse de clusters. La Valeur Pastorale (0-100) des pâturages a été calculée sur la base des index spécifiques (échelle 0-5) des plantes sur lesquelles l'estimation de la charge potentielle devrait être basée. L'analyse de la végétation a déterminé la définition de douze types de pâturage caractérisés par une composition floristique différente.* Festuco-Seslerietea*,* Festuco-Brometea*,* Molinio-Arrhenatheretea *et* Nardo-Callunetea *ont été les classes phytosociologiques principalement représentées. Le calcul de la valeur pastorale a mis en évidence des valeurs variables entre 18,6 et 35,8, respectivement, pour les pâturages de* Sesleria nitida *et* Carex macrolepis *et de* Festuca nigrescens *et* F. circummediterranea*.*

Mots-clés : *Pâturages de montagne, valeur pastorale, charge animale, moutons.*

Introduction

Compared to the characteristics of the sheep production systems traditionally established on the mountains of Italian Central Apennines, described by several authors (Boscaglia, 1920; Pullé, 1937), throughout the second part of the last century consistent reductions in animals number and significant modifications of the flock and grazing management systems were recorded (D'Ottavio *et al*., 2002; D'Ottavio and Scotton, 2002b). That could, in a long-term perspective, determine the occurrence of important modifications of the pasture resources characteristics.

The large range of stocking rates apparently not adjusted to the different productivity of the pastures, found in the Sibillini area by D'Ottavio and Scotton (2002b), could cause negative environmental impact connected to under- and over-stocking. In this regard, the forage selection observed on single plants (mostly legumes and good forage grasses) and their parts (mostly leaves) and on the pasture types with a higher pastoral value (D'Ottavio *et al*., 2004), the large abundance of plants partially or totally refused by sheep (such as *Brachypodium* sp.) or of trees and shrubs (*Juniperus* sp.) recorded in the study area seem to be attributed to general understocking conditions or to the increasing abandonment of the good pastoral practices. On the other side, the increased

abundance of nitrophylous species, sward breaks and grazing-patches, also widespread on large areas of the mountains of Monti Sibillini, are probably related to overstocking conditions not only occurred in the past, when the stocking rate were definitively much higher that now.

Taking into consideration these and other problematic aspects, such as the actual resting paddocks management (D'Ottavio and Scotton, 2002a) the utilisation of pastures in the area of Monti Sibillini urgently requires planning which should be based on principles of sustainable agriculture.

In this context, the present work aims to assess the pastoral value of the most frequent pastures in the National Park of Monti Sibillini, on which the potential stocking rate assessment should be based.

Material and methods

The research was performed in the pastoral unit "Casale Ghezzi" (Castelluccio di Norcia, Perugia province). The bedrock of the study area is calcareous and the climate is characterised by a mean annual temperature of 6.3 °C and a mean annual precipitation of 840 mm with a maximum occurring in spring and autumn and a minimum in August. The studied pastures (1400-2450 m a.s.l) have a total area of around 750 ha; those located below 1800 m a.s.l. were created from original *Fagus sylvatica* woods felled in past centuries in order to increase the grazing areas.

Based on the phytosociological approach (Braun-Blanquet, 1964) 81 vegetation surveys (including the assessment of the topographic and soil characteristics) were performed during the two consecutive summers of 1995 and 1996 on an area of around 300 ha. The vegetation data were analysed by cluster analysis methods (software Mulva-5, Wildi and Orloci, 1990), transforming the abundance values on the base of the Maarel (1972) scale (1-9), using the correlation coefficient and similarity ratio for the species and the relevés, respectively, and the complete linkage as classification algorithm.

The Potential Pastoral Value (PPV: 0-100) of the different pasture types was assessed according to Daget and Poissonet (1971). It is based on the Specific Indexes (SI) of forage plants (scale 0-5, according to Delpech, 1960) reported by Roggero *et al.* (2002) and by D'Ottavio *et al.* (2000) considering both the forage value and productivity.

The mean of the Specific Indexes of forage species present in each plot, weighted by their abundance, constitutes the pastoral value of the survey. The mean of the pastoral survey values corresponding to the same pasture type constitutes its pastoral value.

Results and discussion

Characterisation of the pasture types

The vegetation analysis led to the definition of 12 pasture types characterized by different species composition (Table 1). *Festuco-Seslerietea*, *Festuco-Brometea*, *Molinio-Arrhenatheretea* and *Nardo-Callunetea* were the most frequent phytosociological classes.

Pasture type 1, dominated by *Sesleria tenuifolia* and *Carex kitaibeliana,* develops on consolidated slopes, also considerably steep, and on the crests. Apart from the dominant species, the more frequent and abundant species that mostly contribute to determine its aspect, characterised by steps and discontinuous coverage, are *Festuca curvula* and *Helianthemum oelandicum* ssp*. canum*.

Pasture type 2, dominated by *Globularia cordifolia* and *Helianthemum oelandicum* ssp. *canum,* develops on slopes characterized by the presence of rocky breakthroughs. Its aspect as an open and discontinuous pasture is not dissimilar to the previous type, however, the presence of the dominant and other accompanying species, due to their high coverage, better characterise the pasture.

Pasture type 3, dominated by *Sesleria nitida* and *Carex macrolepis,* develops on very steep slopes and is characterised by intensive cryoclastic action. It is an arid pasture whose aspect, determined mainly by the dominance of *S. nitida*, is characterised by typical steps that give origin to a discontinuous sward with constituent and frequent rocky breakthroughs.

Table 1. Characteristics, floristic composition and pastoral value of the pasture types. Mean values of the vegetation surveys. Abundance (%) of the most abundant and frequent species

	Pasture type†	1	2	3	4	5	6	7	8	9	10	11	12
	Altitude (m a.s.l.)	1852	1714	1784	1863	1731	1663	1645	1711	1698	1654	2108	2118
	Exposure (declination from N)	181	209	226	239	233	297	129	212	84	146	240	203
	Slope (degrees)	22.1	18.0	27.8	28.9	24.3	13.7	17.5	17.4	11.3	0.5	18.0	4.2
	Soil depth (mm)	229	308	402	507	591	408	295	589	616	760	440	773
	Soil pH	7.0	6.1	6.9	7.0	5.1	6.3	5.3	5.3	4.9	5.5	4.8	4.7
	Vegetation cover (%)	55.1	69.0	58.7	38.3	94.2	98.7	97.0	92.9	89.0	98.3	100	99.0
	Mean species number	29.9	40.1	31.5	28.6	42.8	44.0	43.5	39.7	39.5	27.0	30.0	21.2
	Grasses number	5.8	6.6	7.5	5.4	9.9	7.3	8.3	8.6	10.8	6.0	4.3	5.4
	Legumes number	2.8	4.7	3.7	1.7	4.2	5.0	6.0	4.6	3.5	1.8	2.0	1.6
	Other species number	21.4	28.9	20.3	21.4	28.7	31.7	29.3	26.6	25.3	19.3	23.7	14.2
	Grasses % abundance	56.1	54.7	64.6	64.3	78.2	56.9	62.7	67.8	78.2	59.6	29.2	72.6
	Legumes % abundance	5.4	4.2	3.6	0.7	1.8	5.5	2.0	6.9	3.0	7.3	7.2	2.6
	Other species % abundance	38.5	41.1	31.8	35.0	20.0	37.6	35.3	25.3	18.8	33.1	63.6	24.7
SI††	Potential Pastoral Value	21.8	19.6	18.6	19.0	23.0	25.1	22.0	26.6	21.4	35.8	32.3	19.5
1[a]	*Sesleria tenuifolia* ssp. *tenuifolia*	17.0	.	0.2	14.7	.	.	.	.	.	.	.	.
2[b]	*Carex kitaibeliana*	8.2	0.2	.	4.1	10.0	.	.	.	.	.	5.0	6.0
1[a]	*Sesleria nitida*	4.0	.	9.4	0.2	.	.	.	.	.	.	.	.
0[a]	*Carex macrolepis*	.	.	1.7	0.2	1.9	.	.	.	.	.	.	.
1[b]	*Festuca dimorpha*	0.2	.	16.7	13.6	.	.	.	.	.	.	.	.
2[a]	*Festuca violacea* ssp. *macrathera*	2.7	4.1	1.4	3.7	1.0	.	.	.	.	.	.	.
1[a]	*Festuca curvula* ssp. *curvula*	8.7	8.7	3.4	4.1	12.0	.	22.5	5.0	.	.	.	.
3[a]	*Medicago lupulina*	0.2	0.5	0.2	0.2	0.3	.	.	2.8	.	.	.	.
2[a]	*Bromus erectus* ssp. *erectus*	3.3	8.0	4.8	2.2	4.9	10.7	9.5	2.1	0.2	.	.	.
0[b]	*Globularia cordifolia*	2.2	7.7	0.6	.	1.1	0.2	6.9	0.2	.	.	.	.
1[b]	*Hypochoeris cretensis*	0.2	1.0	0.3	0.2	.	1.0	.	0.2	.	.	10.5	.
0[b]	*Thymus striatus*	2.2	2.4	4.9	1.1	4.0	4.3	5.8	2.3	1.1	.	4.0	2.5
2[a]	*Koeleria splendens*	1.4	4.6	2.7	1.0	3.6	4.7	3.8	1.6	0.5	.	.	.
0[a]	*Euphorbia cyparissias*	0.2	2.5	0.3	0.4	4.1	.	1.0	8.4	3.0	0.7	.	.
0[b]	*Verbascum longifolium*	.	0.8	.	0.2	0.6	0.1	.	3.8	1.1	11.0	.	.
1[a]	*Brachypodium genuense*	8.7	7.9	5.6	3.4	31.8	11.3	0.2	28.6	16.8	0.2	0.2	.
0[a]	*Hieracium pilosella s.l.*	0.5	1.0	0.7	0.2	3.0	9.3	11.5	2.0	4.3	0.2	0.2	0.2
0[a]	*Carlina acaulis* ssp. *caulescens*	0.3	2.9	2.1	0.5	0.3	7.0	0.1	0.4	1.4	2.0	0.2	0.1
2[a]	*Poa alpina* ssp. *alpina*	0.9	6.7	1.6	1.1	2.0	4.0	0.7	2.2	1.6	0.2	2.7	3.0
4[a]	*Trifolium pratense* ssp. *pratense*	0.7	0.2	0.2	0.2	0.3	1.0	0.2	0.4	0.9	0.9	3.1	3.1
0[b]	*Potentilla recta*	0.6	1.3	1.0	.	1.3	2.3	1.6	0.9	1.1	.	0.7	0.2
1[a]	*Avenula praetutiana*	0.2	3.4	1.0	0.6	1.3	4.0	0.2	1.2	2.8	.	1.6	1.0
2[a]	*Plantago atrata*	.	0.2	.	0.1	0.2	0.2	.	0.2	0.2	.	26.3	11.1
2[a]	*Festuca nigrescens s.l.*	.	.	.	.	10.4	20.3	27.3	9.9	7.3	19.8	24.7	18.6
1[a]	*Anthoxanthum odoratum*	.	0.1	.	.	1.6	8.0	6.8	3.0	3.3	.	0.1	1.1
2[a]	*Festuca circummediterranea*	.	2.5	2.0	.	7.6	.	.	20.9	4.7	19.8	.	.
4[a]	*Trifolium repens* ssp. *repens*	.	0.1	.	.	0.2	.	0.2	8.1	1.3	8.7	.	2.0
1[a]	*Bellardiochloa violacea*	.	.	.	.	17.0	2.0	0.6	1.5	25.0	17.0	.	0.2
3[a]	*Agrostis capillaris*	.	.	.	.	0.6	0.2	0.2	0.2	2.4	4.5	.	.
2[b]	*Carduus affinis* ssp. *affinis*	.	.	.	.	.	.	.	0.2	.	18.7	.	.
1[a]	*Crepis aurea* ssp. *glabrescens*	.	.	.	.	.	.	.	.	.	.	15.7	0.2
2[a]	*Trifolium thalii*	.	.	.	.	.	3.0	.	.	.	.	6.5	0.2
0[a]	*Nardus stricta*	.	.	.	.	10.0	.	.	.	9.5	.	1.7	48.0
3[a]	*Alopecurus pratensis*	.	.	.	.	.	.	.	.	.	14.0	.	.
	Other species	29.3	28.3	17.7	25.7	22.9	32.6	25.8	32.8	15.5	24.3	9.65	10.6

† See legend in the text.
†† SI: Specific Index; [a]: most frequent SI in Roggero *et al.* (2002); [b]: SI calculated according to D'Ottavio *et al.* (2000).

Pasture type 4, dominated by *Festuca dimorpha* develops typically on gravelly soils and on very steep screes. It is characterised by low vegetation cover of the dominant grasses and other pioneer species that fix the substratum and limit the fall of deposits.

Pasture type 5, dominated by *Brachypodium genuense,* frequently develops on gravelly soils where the deposits are stable or only slightly mobile. Such conditions allow *B. genuense* to spread

diffusely. The high dominance of this species and of some other grasses with high vegetation cover indexes, confers to the pasture a dense coverage that often conceals the slopes typically characterised by large steps on which it grows.

The pastures dominated by *Festuca nigrescens* (type 6) and by *Anthoxanthum odoratum* (type 7) develop on slightly sloped surfaces or on flat mountain tops. Though presenting a good degree of homogeneity from a floristic point of view, they differ substantially in their aspect. The first is a closed pasture constituted by a typical short vegetation; the second one is characterized by the presence of numerous tussocks of the dominant species (*Festuca curvula* and *F. nigrescens*), among other species (above all *Anthoxanthum odoratum* and *Hieracium pilosella*).

The pasture dominated by *Euphorbia cyparissias* and *Verbascum longifolium* (type 8) colonises the surfaces surrounding the plain or slightly sloping areas occupied by the *Bellardiochloa violacea*-pasture (type 9) or by *Festuca nigrescens*- and *F. circummediterranea*-pasture (type 10). The aspect of the pasture type 8 is once more characterised by the high abundance of *Brachypodium genuense* and plants of the genus *Festuca* (*F. circummediterranea* and *F. nigrescens*), and by the remarkable and constant presence of *E. cyparissias* and *V. longifolium* (rarely also of *Digitalis ferruginea*). Pasture 9 presents an aspect fundamentally closed characterized by the presence of the big and compact tussocks of *B. violacea* and by other grasses of medium and tall size (*Brachypodium genuense*, *F. circummediterranea* and *F. nigrescens*). Pasture type 10 has a high degree of vegetation cover due to the high abundance of its principal components: *F. nigrescens*, *F. circummediterranea*, *B. violacea* and sometimes *V. longifolium*, *Cirsium morisianum*, *Carduus affinis* and rarely also *Digitalis ferruginea*.

The *facies* dominated by *Festuca nigrescens*, *Plantago atrata* and *Crepis aurea* ssp. *glabrescens* (type 11) develops on flat ground or on slight gradients situated along the edges of the hollows and on the large steep stable slopes of the higher altitudes of the principal mountains, generally characterised by longer snow permanence. It presents a dense coverage constituted by a continuous and homogeneous sward, short and closely woven.

The grassland dominated by *Nardus stricta* (type 12) occupies the flat basin of the hollows and the large flat areas located at the higher altitudes with deep and acid soils. The typical *facies* is characterised by the dominance of mat-grass on the other species and by high vegetation coverage.

Potential Pastoral Value of the pasture types

The assessment of the PPV showed values varying between 18.6 and 35.8 for the *Sesleria nitida*- and *Carex macrolepis*- and for the *Festuca nigrescens*- and *F. circummediterranea*- dominated grasslands respectively (Table 1).

In general, the highest pastoral values (on average 28.4) were recorded in the pasture types dominated by species with SI equal to 2 (on average about 47%) (mod. 2, Fig. 1).

The lowest values (on average 20.8 and 19.5, respectively) were recorded in the pasture types characterised by the dominance of species with SI equal to 1 (on average about 54%) (mod. 1) and in the pastures which, despite showing an abundance of species with SI of 2 (on average about 36%), presented the dominance of species with SI equal to 0 (on average about 45%) (mod. 3).

In general, the different pasture types presented a decreasing number of species with increasing SI (Fig. 2).

Despite the lowest % abundance of the legumes (on average 4.2%), compared to grasses and to the other species with 62.1 and 33.7% respectively, their high palatability and quality (D'Ottavio *et al.*, 2000) increased more than 40% their contribution to the formation of the pastoral value, which was, furthermore, positively correlated to the abundance of legumes (Fig. 3) in the studied pastures.

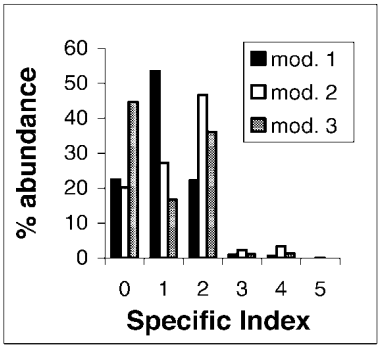

Fig. 1. % abundance of the species with different SI.

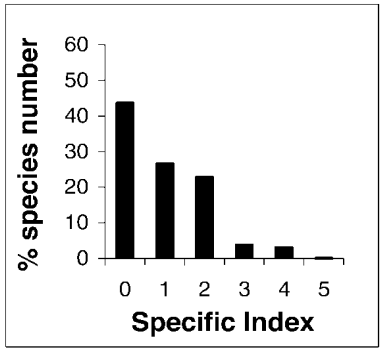

Fig. 2. % number of species with different SI.

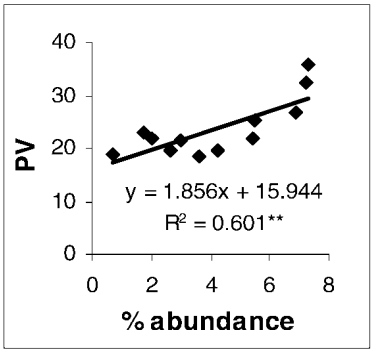

Fig. 3. Relationship between PV and % abundance of legumes of the pasture types.

Conclusions

The vegetation analysis led to the definition of 12 pasture types of different species composition and environmental characteristics. The assessment of the PPV showed the high influence on its formation of the abundance good forage species growing in the pasture types. Among all, the legumes were the species that could better contribute to improve the pastoral values of the pasturelands.

According to Cemagref (1983), based on the PPV assessed, a Corrected Pastoral Value (CPV) should be calculated taking into account a Fragility Coefficient (FC: 0.8-1.0) of the different pastures determined by considering the structural instability of the soil, the evidence of erosion and the slope if greater than 50%. In addiction, according to Cemagref (1987), based on the CPV the assessment of the potential stocking rate of the pastures should take into account their different altitudes.

References

Boscaglia, G. U. (1920). *Greggi e Pastori (Agro Grossetano e Romano)*. Le Vie d'Italia. Touring Club Italiano. Anno IV. N 7. pp. 407-416.

Braun-Blanquet, J. (1964). *Pflanzensoziologie. Grundzuge der Vegetationskunde,* III edn, Springer Verlag, Wien, New York.

Cemagref (1983). *Pastoralisme montagnard, recherches en briançonnais*. Etude n° 188. St. Martin D'Heres.

Cemagref (1987). *Exploitation de pelouses et landes subalpines par des bovins et des ovins.* Compte-rendu de recherche n° 211. St. Martin D'Heres.

Daget, P. and Poissonet, J. (1971). Une méthode d'analyse phytologique des prairies. Critères d'application. *Ann. Agro.*, 22 (1), 5-41.

Delpech, R. (1960). Critères de jugement de la valeur agronomique des praires. *Fourrages*, 4: 83-98.

D'Ottavio,P. and Scotton, M. (2002a). Modalità di utilizzazione di pascoli ovini nel Parco Nazionale dei Monti Sibillini (Appennino Centrale). *Monti e Boschi,* Anno LIII, no. 5 sett.-ott. 2002, pp. 18-25.

D'Ottavio, P. and Scotton, M. (2002b). Stocking rate distribution and grazing management systems adopted by sheep farms in the territory of Castelluccio di Norcia (Monti Sibillini National Park, Central Italy). In: *Proceedings of the 2nd International Congress "Environment and identity in the Mediterranean",* Corte (Corsica, France), 3-5 July 2002, pp. 543-557.

D'Ottavio, P., Scotton, M. and Ziliotto, U. (2000). Legumes in mountain pastures of Monti Sibillini (Central Apennines, Italy) grazed by sheep. *Grassland Science in Europe,* 7: 286-288.

D'Ottavio, P., Scotton, M. and Ziliotto, U. (2002). Flock and grazing management systems adopted by sheep farms in the Monti Sibillini National Park (Italy). *Grassland Science in Europe,* 7: 912-913.

D'Ottavio, P., Scotton, M. and Ziliotto U. (2004). Forage selection by sheep in extensive grazing systems in the Monti Sibillini National Park (Central Apennines, Italy). *Options Méditerranéennes, Series A*, 61, 189-192.

Maarel, E. van der (1972). *On the transformation of cover-abundance values in phytosociology*. Report Bot. Lab. Nijmengen.

Pullè G. (1937). La pastorizia transumante nell'Appennino Umbro-Marchigiano. *L'Universo,* Anno XVIII, no. 4-5. Aprile-Maggio 1937-XV.
Roggero, P.P., Bagella, S. and Farina, R. (2002). Un archivio dati di Indici Specifici per la valutazione integrata del valore pastorale. *Riv. Agron.*, 36: 149-156.
Wildi O. and Orloci L. (1990). *Numerical exploration of community patterns*. SPB Academic Publishing bv, The Hague. 124 p.