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Comparison between sheep and cattle grazing behaviour in native low-mountains pasture

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SUMMARY - The effects of rotational grazing by sheep and cattle were investigated in a low mountain environment between 1981 and 1987. The experiment was set up on a native pasture divided into 10 paddocks, each of which was subdivided in two halves separately utilized by either lactating sheep or heifers. In this paper the main results regarding grazing behaviour (pasture utilization, forage selection, and grazing time) are reported emphasizing differences between cattle and sheep. Some grass species (*Dactylis glomerata*, *Poa pratensis*) and *Trifolium repens* were consistently utilized; *Bromus inermis*, *Festuca arundinacea* and *Festuca rubra* were clearly preferred by cattle, while some other legumes (*Lathyrus* spp. and *Vicia* spp.) were positively selected by sheep. Some invading shrubs (*Sambucus* spp. and *Viburnum* spp.) and ferns (*Pteridium aquilinum*) were better controlled by cattle; on the other hand *Rosa* spp. and *Rubus* spp. were partially defoliated only by sheep. Modified point quadrats method applied in small areas have allowed the detection of selective behaviour through the analysis of the main pasture species utilization. Sheep demonstrated a higher selective ability throughout the grazing season, but with wider differences in summer, when pasture quality was lower. Comparing the grazing activity of the two species, it was possible to note a relatively higher daily variation of the grazing time spent by the flock.

Key words: Sheep, cattle, selection, grazing behaviour, grazing time.

RESUME - "Comparaison du comportement au pâturage des ovins et des bovins sur des pâturages naturels dans des zones de faible altitude". On a fait des recherches sur les effets du pâturage à rotation des ovins et des bovins de 1981 à 1987. L'exploitation a été fixée sur un pâturage naturel divisé en 10 parcs et chacun d'eux en deux moitiés utilisées l'une par des brebis et l'autre par des génisses. On rapporte ici les principaux résultats sur le comportement au pâturage (utilisation du pâturage, sélection du fourrage et temps de pâturage) en faisant remarquer les différences entre ovins et bovins. Quelques espèces (Poa pratensis, Dactylis glomerata et Trifolium repens) ont été utilisées de façon considérable; Bromus inermis, Festuca arundinacea et Festuca rubra ont été nettement préférées par les bovins, tandis qu'aucune légumineuse (Lathyrus spp. et Vicia spp.) n'a été choisie par les ovins. Quelques arbustes envahissants (Sambucus spp. et Viburnum spp.) et fougères (Pteridium aquilinum) ont été mieux contrôlés par les bovins; tandis que Rosa spp. et Rubus spp. ont été partiellement défoliées exclusivement par les ovins. Un changement de la méthode d'analyse linéaire (point quadrats) appliquée sur de petites surfaces a permis de contrôler le comportement sélectif à travers l'analyse de l'utilisation des principales espèces du pâturage. Les ovins ont démontré une capacité de sélection plus élevée pendant toute la saison de pâturage, mais de façon plus prononcée en été, lorsque la qualité du pâturage était diminuée. En comparant l'activité de pâturage des deux espèces, il a été possible de remarquer une variation quotidienne du temps de pâturage relativement plus élevée pour le troupeau des brebis.

Mots clés : *Ovins, bovins, sélection, comportement au pâturage, temps de pâturage*

Introduction

Animals' grazing behaviour is conditioned by external factors, i.e. climate, soil, slope and vegetation, and by internal factors i.e. species, individual conditions (age, sex, pregnancy, hierarchical class, etc.) (Cook, 1966; Arnold, 1981).

Among features connected with "grazing behaviour", diet composition influences more directly the change and/or the sward conservation (Arnold and Dudzinski, 1978; Stephens and Krebs, 1986; Malechek and Narjisse, 1990); in fact, grazing animals make a selection of grass that is more marked when grass availability is high, vegetation's composition and grass growth intensity are more variable and when shepherd control is more reduced.

Many studies have been carried out on selective grazing pressure made by livestock, pointing out the capability of sheep in comparison with cattle to keep a more constant diet composition during the season (Hodgson and Eadie,1986; Arnold, 1981). Natural pasture necessarily brings about a less balanced resource exploitation because of the selection among the different coenoses and species. This can result in the most preferred species being overutilized and being unable to adequately compete with the underutilized species (Leight e Mulham, 1966; Caputa and Scehovic, 1974; Wettstein and Charles, 1981). Most studies concern the effects of extensive and semi-intensive system, little information is available on sheep's grazing behaviour under intensive management.

This study, within a project on the recovery and productive utilisation of abandoned low mountain pasture using sheep and cattle (Cavallero *et al.*, 1983, 1987, 1988; Reyneri *et al.*, 1989), examines the behaviour of these species within highly controlled grazing conditions.

Material and methods

The observations were carried out from 1981 to 1987 on a native pasture located in the north Ligure-Piemontese Appennine (Castino) in the Alta Langa at 600 m a.s.l. (8°08'E, 44°46'N) within the auspice of a sub-network FAO on mountain pastures.

This 4 ha pasture had an average slope of 30% and has been managed under a rotational grazing system. It was divided into ten paddocks, each one subdivided into two halves separately utilized by sheep and cattle. This pasture organisation has brought about an intensive utilization with instantaneous stocking rates of over 10 LU (livestock unit = 500 kg liveweight) per ha. The main information about the trial are given in Table 1.

Application of P-K fertilizer has been carried out on all paddocks, while in one half

nitrogen fertiliser (urea) was added. The flock was made up of 50 kg average liveweight ewes and their lambs of Garessina breed and the herd of Piemontese heifers (230 kg average liveweight). Feeding was based on pasture grass with hay supplementation at the beginning of the grazing season and sometimes in drought period. No shelter was provided and the animals remained on the pasture throughout the day. Each paddock had watering points and mineral salts blocks.

Table 1. Main trial management notes

	Sheep	Cattle
Pasture organization		
Available area (ha)	2	2
Grazing period (days)	165	165
Rotational paddocks (no.)	10	10
Cycles (no.)	5	5
Stocking rate average (LU* ha^{-1})	1.33	1.32
Real stocking rate (LU* ha^{-1} $year^{-1}$)	0.60	0.59
Grazing animals		
Heads (no.)	18	7
Liveweight (kg)	49	232
Lamb for ewe (no.)	1.3	
Lamb liveweight (kg)	23	
Meat production (kg ha^{-1})	91	127
Grass production		
Available grass (DM t ha^{-1} $year^{-1}$)	2.7	2.3
Refused grass (DM t ha^{-1} $year^{-1}$)	1.6	1.3
Utilization coeff. (%)	40	43
Fertilisation (kg ha^{-1})		
No N = N:P_2O_5:K_2O = 0:50:50 paddocks (no.)	5	5
N = N:P_2O_5:K_2O = 50:50:50 paddocks (no.)	5	5

* LU = Liveweight Unit (500 kg)

In other studies more detailed issues are given about vegetation (Acutis *et al.*, 1989), agronomical (Cavallero *et al.*, 1987) and animal (Bianchi and Battaglini, 1986)

features. Pasture herbage biomass was determined at the start and at the end of each grazing period cutting at the height of 1-2 cm according to the microrelief. Quality was determined on pre and post grazing samples and ingested herbage quality assessed by difference.

The analysis of grazing animals' behaviour has been carried out by comparing: (i) the consumption of the pasture's main herbaceous, shrubs and trees species; (ii) Diurnal behaviour of pattern.

The analysis of herbaceous species' and categories' consumption has been made at the end of every grazing cycle on 10 paddocks by means of point quadrat modified as follows. At a regular distance (every 20 cm) on 4 m fixed lines, situated between two metal plates fixed in the ground, all species along the vertical traverse of a needle were detected; for each species the degree of selection was estimated by using a four level scale: not defoliated (1); slightly defoliated (2); medium level of defoliation (3); and severely defoliated (4). That correspond on average at 0, 25, 50 and 75% consumption of plant materials existing at the beginning of the cycles.

This analysis allowed: (i) the estimation of the main species' average utilization and the establishment of the preference order of each animal species, season and mineral fertilisation treatment; and (ii) the evaluation of the grazing animals' selective capability.

This capability was determined by measuring, for each observation point, the difference between the maximum and the minimum defoliation level of the present plant species.

It was hypothesised that the greater the difference in the degree of selection of the species the greater the selection capability by the animal species. According to this it was estimated that a high degree of selection corresponded to at least 3 levels, medium of 1 or 2 and none with no differences among plant species.

Visual analysis on marked plants were adopted to evaluate the consumption and the trampling effect on shrubs and trees species.

The records of the diurnal grazing pattern were made by means of direct observations of the animals throughout the day and repeated during the grazing period of the trial's first year.

Results

Grazing animals preferences

Herbaceus species

The range of consumption of the main herbaceous species' or forage categories'

is given in Fig. 1. These values have been indexed in order to correct for the different degree of utilization to which they are subject during the successive grazing cycles (the average of important species always present - *Agropyron repens*, *Arrhenatherum elatius*, *Dactylis glomerata* and *Poa pratensis* - was calculated to be equal to 100).

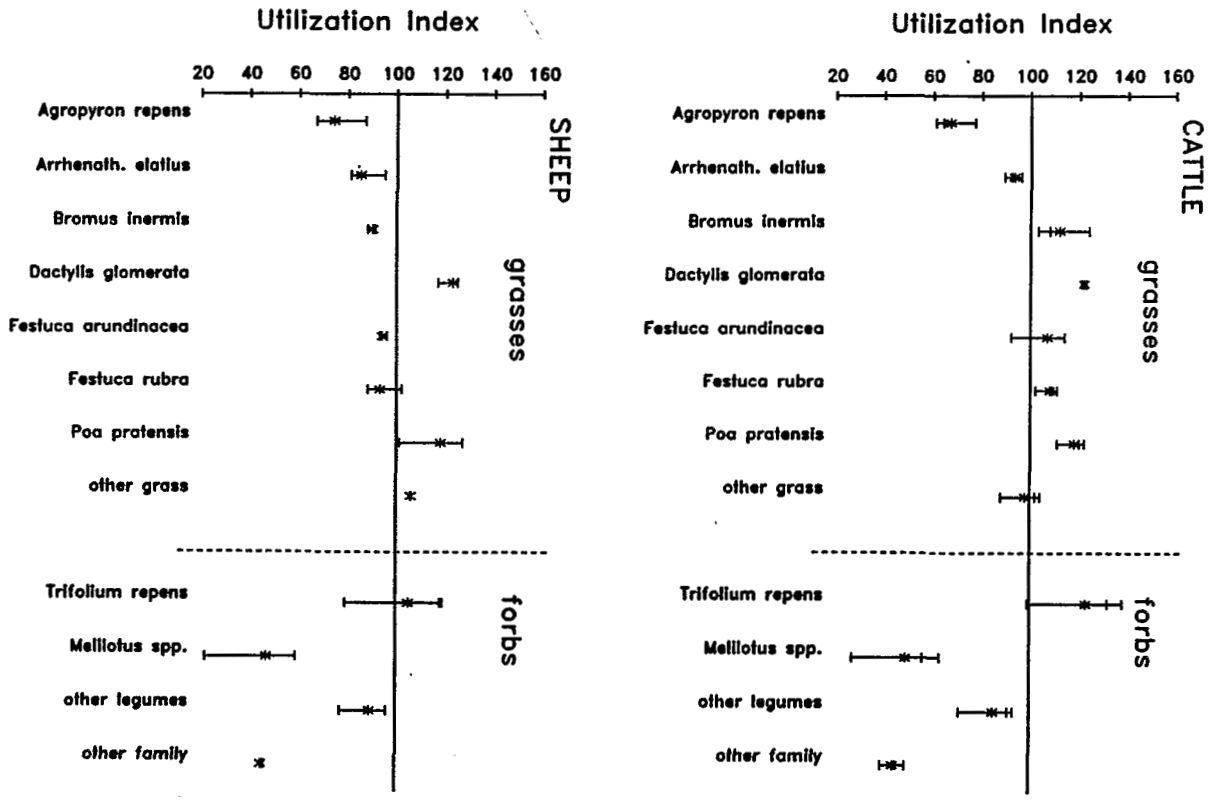

Fig. 1. Range of herbaceous species utilization index at pasture by sheep and cattle (* = mean).

It was found that - even with some variations mainly linked to the grass' phenological stage at the time of utilization - under the intensive grazing conditions of this trial, the two grazing animal species have similar feeding preferences. *Dactylis glomerata*, *Poa pratensis* and *Trifolium repens* seem to be equally well utilized, *Bromus inermis*, *Festuca rubra* and *Festuca arundinacea* appeared preferred by cattle while *Agropyron repens*, *Melilotus* spp. and the other dicotiledons are always underutilized.

For instance in the herbaceous coenoses in which a singular species is dominant (particularly *Festuca arundinacea* and *Bromus inermis*) this species is more utilized rather than when it is less abundant. In the herbaceous coenoses in which several species are present in similar amounts, the selective effect of animals is more marked: in these conditions *Dactylis glomerata*, *Poa pratensis* and *Trifolium repens* are mainly grazed.

The degree of selection of *Agropyron repens* and *Festuca arundinacea* by the animal species appears to be related to an evident palatability's change linked to the phenological stage.

Nitrogen fertilisation increased the consumption of *Trifolium repens* while it reduced the consumption of *Festuca arundinacea* and *Festuca rubra* and, in the case of sheep, *Agropyron repens* (Table 2). These modifications of relative consumption seem to be due to a short term effect of N fertilizer on leaf palatability for tall and red fescue; on the other hand an increase in herbage availability lead to an underconsumption of the less palatable species such as wheatgrass.

Table 2. Relative herbaceous species consumption related to nitrogen fertilisation

	Sheep		Cattle		EMS
	no N	N	no N	N	(DF=25)
Agropyron repens	99.2	66.0 *	73.4	70.3 ns	189
Arrhenatherum elatius	76.8	90.6 ns	89.2	90.6 ns	454
Bromus inermis	94.0	104.9 ns	118.3	101.8 ns	213
Dactylis glomerata	116.1	121.5 ns	119.6	122.7 ns	171
Festuca arundinacea	99.0	80.9 *	114.1	101.6 *	101
Festuca rubra	84.5	106.7 *	116.1	100.6 *	80
Poa pratensis	107.9	122.0 ns	117.8	116.4 ns	371
Other grasses	95.2	109.5 ns	101.6	92.2 ns	153
Trifolium repens	85.3	118.9 *	94.1	131.0 *	208
Melilotus sp.	59.8	59.0 ns	76.6	44.1 *	153
Other legumes	101.5	79.3 ns	87.0	84.3 ns	756
Other forbs	44.3	45.4 ns	46.9	42.8 ns	454

* Significance $P<0.05$; ns = non significant.

Such variations are not easy to explain, since they depend on the availability, the size, the leafness and the other qualitative parameters affected by nitrogen supply. They also show that the palatability of a species is changeable and influenced by a wide series of factors such as the plants' vegetative stage and feeding level, the amount of grass, the presence of coenoses with species having different palatability,

etc., which largely influence grazing behaviour and the consequent sward vegetational change.

Shrubs and trees species

Table 3 shows the utilisation degree and the control of the main shrubs and trees species for the two animal species.

Table 3. Trees and shrubs consumption and control with grazing sheep and cattle

	Consumption[1]		Decrease reason[2]	
	Sheep	Cattle	Sheep	Cattle
Shrubs				
Clematis vitalba		+		
Cornus sanguinea	++	++		
Ononis natrix[3]	+	+		A
Pteridium aquilinum	+	-	A	B
Rosa sp.	+	-		
Rubus fruticosus	+	-	A	
Sambucus ebulus	-	-		B
Viburnum lantana	-	-		B
Trees				
Acer spp.	+	+	A	A
Castanea sativa [3]	+	+		
Corylus avellana [3]	+	++		
Pinus sylvestris	++	+	A	A
Populus spp.	++	++	A	A
Prunus cerasus	++	++		
Quercus pubescens [3]	+	+		
Robinia pseudoacacia	++	+	A	A
Salix caprea	+	-		

[1] - absent, + low, ++ good.
[2] A consumption, B trampling.
[3] Almost exclusively spring utilisation.

For shrubs, cattle exerted a favourable control action by means of trampling on particular middle-size herbaceous-shrub species such as *Pteridium aquilinum* and *Sambucus ebulus*; in contrast this last species, particularly, was spreading in the sheep utilized areas. Sheep, by consuming *Rubus fruticosus*' shoots and leaves, limited their growth and cover.

A more efficacious reduction of shrubs (particularly of invading species such as *Sambucus ebulus* and *Rubus fruticosus*) can be obtained by means of the two species mixed grazing (Reyneri *et al.*, 1989).

As to trees species' consumption and control a fairly similar behaviour, for the two animal species, was observed, apart from an improved consumption of leaves of *Pinus Sylvestris* and *Robinia pseudoacacia* by sheep and of *Corylus avellana* by cattle.

On the other hand, cattle exerted a double action towards trees and shrubs through shoots and leaves utilisation and in addition efficacious control by the trampling and by the breaking of saplings.

Grazing animals' selective capability

Animals' selective capabilities were evaluated in every paddock giving by percentage the amount of differences (from 0 up to 3) determined in the degree of selection between the most and the least consumed species for each sample point.

Sheep, as foreseen, showed a more accentuated selective capability in summer and autumn (Fig. 2). The ungrazed plot was, on the whole, relatively constant (60%).

As to the cattle's behaviour, the grazing selection was shown to be higher during spring and progressively less marked during summer and autumn. The percentage of the selected surface (considered as the sum of high and medium degree of selection) seems to be correlated to grass availability (Fig. 3). It is possible to observe that cattle maintain constant the level of grass intake. On the other hand sheep were more dependent on herbage allowance variations.

Diurnal pattern behaviour

Grazing time

Sheep and cattle showed different grazing behaviour patterns during the day (Fig. 4); cattle grazed longer than sheep (8-9 hours) in well separated bouts. During spring, cattle grazed during two phases, morning and late afternoon, when the temperature was between 11 and 18°C.

During midsummer heifers grazed more frequently in the first few hours after sunrise, when thermal conditions were more favourable (temperature between 17 and 20°C). During autumn active grazing was concentrated in the middle of the day because of the lower number of day light and the more contained maximum temperatures (12-18°C).

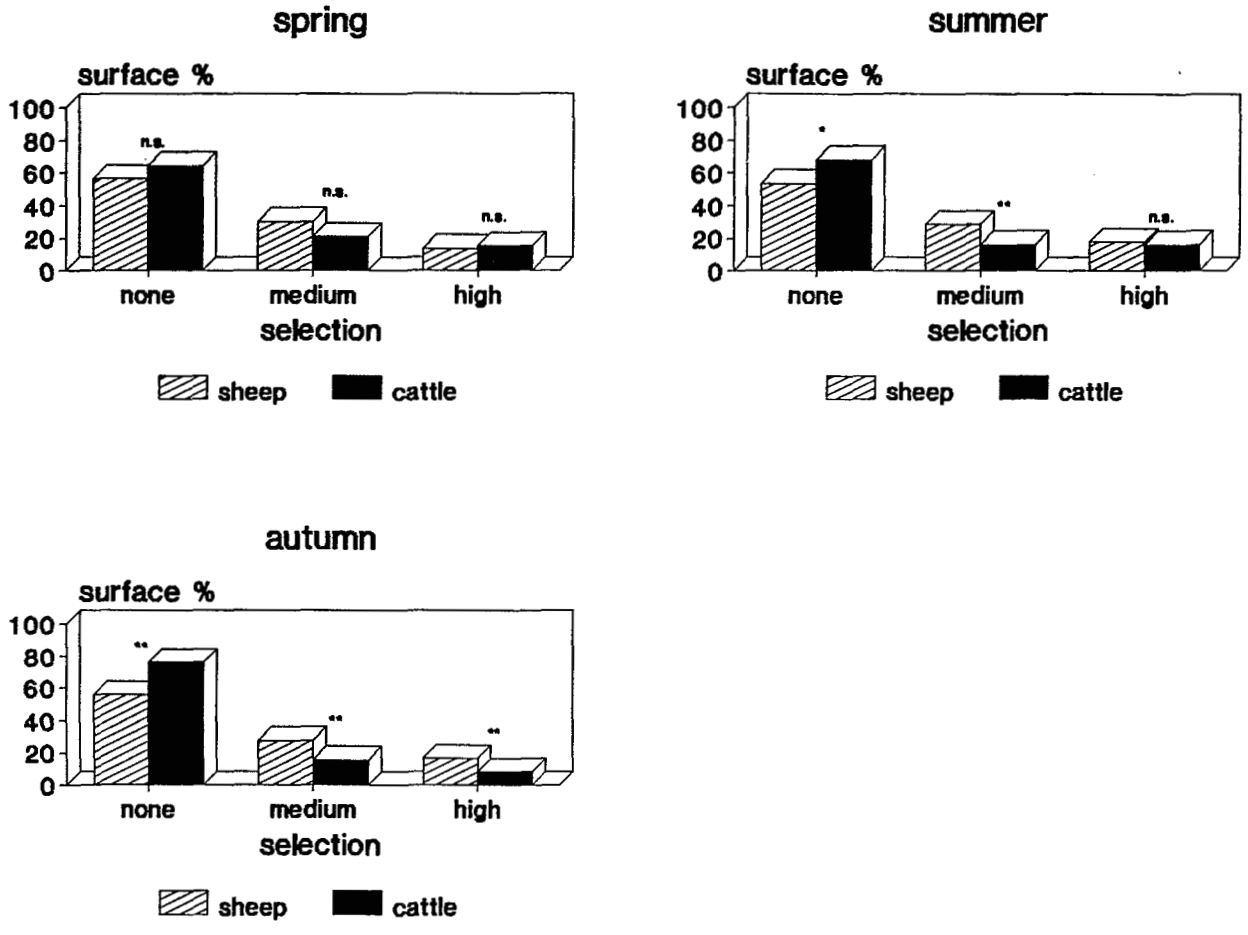

Fig. 2. Selective capability of sheep and cattle in spring, summer and autumn times ($P<0.05$: *; $P<0.01$: **; n.s.: not significant).

In contrast to cattle, sheep were more sensitive to high temperatures and to irradiation, concentrating grazing activity in the cooler hours of morning and evening. During autumn sheep showed greater differences than cattle preferring a grazing time divided into two different bouts.

From Fig. 3 it can be seen the increase in the herd's active grazing hours has a linear correlation with the herbage availability reduction. In an attempt to keep constant grass intake, cattle prolonged grazing time from 8 up to 10 hours with declining herbage availability. The rate of this behaviour is equal to one hour for every reduction of 500 kg DM per hectare of grass. This was particularly evident in autumn when grass availability was considerably reduced. On the other and, sheep did not increase their active grazing hours which were limited on average to 6-7 hours by day, but showed a seasonal requirements trend (birth concentrated at the beginning of spring) that agrees with that of offered grass.

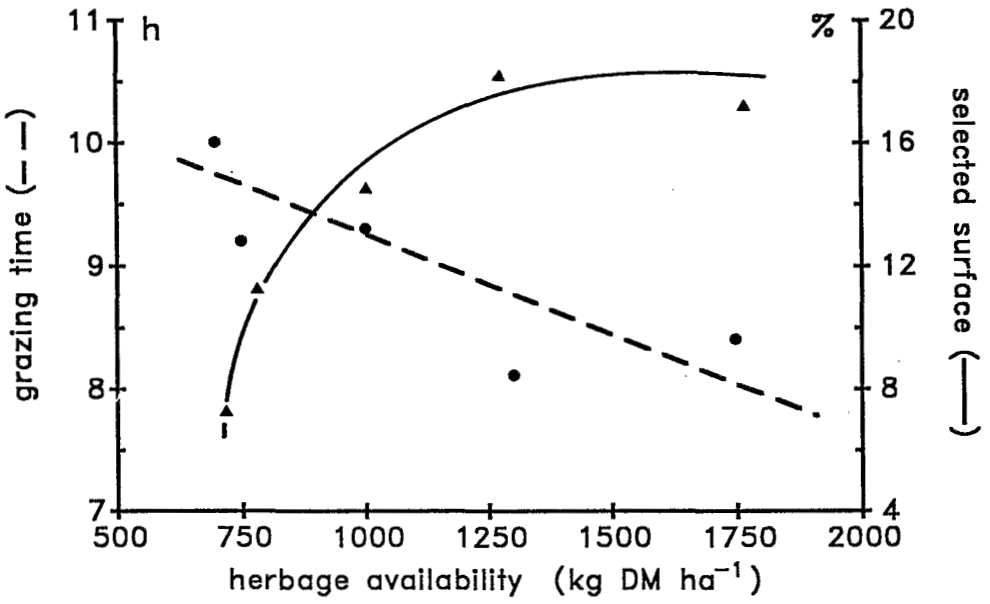

Fig. 3. Herbage availability, selected area and grazing time relationships on the cattle pasture.

Further remarks on behaviour

As expected for mediterranean breeds sheep grazed in a group, while heifers showed more individual behaviour. As to resting areas choice, the two species preferred flat areas or areas next to drinking points or salt blocks.

It was observed that while sheep preferred grazing areas with a low sward, cattle preferentially rested on particularly rich herbaceous vegetation areas. Even with intensive grazing conditions an irregular faeces'distribution was observed for both animal species, next to resting areas.

It is therefore possible to observe an increasingly extreme fertility gradient as the pasture utilization period proceeds. If not remedied, it can result in a regression of pasture vegetation for lack of nutritive elements in the more difficult and exposed areas, and for excess in the well situated ones.

Fodder's quality variations

In Table 4 it is possible to observe the main results relevant to aspects of chemical composition and nutritive value. Differences are particularly evident between available and refused biomass regarding Metabolizable Energy (ME), Milk Fodder Unit (UFL) and digestible protein for both animal species; and, just for cattle, for protein and crude fibre.

Table 4. Grass chemical composition and nutritive value: comparison among production, animal species and season

	no.	crude prot. DM %	Crude fib. DM %	ME kcal DM kg^{-1}	Milk F.U.(UFL) DM kg^{-1}	Dig. prot. g DM kg^{-1}
Production						
available						
sheep	9	13.32^{bc}	26.77^{ab}	2299^{b}	0.80^{b}	83.36^{b}
cattle	9	14.26c	25.11^{a}	2429^{b}	0.83^{b}	91.24^{b}
refused						
sheep	8	12.10^{ab}	29.02^{b}	2069^{a}	0.70^{a}	73.36^{a}
cattle	9	11.49^{a}	29.07^{b}	2053^{a}	0.70^{a}	69.63^{a}
Production						
available						
spring	6	12.70^{b}	25.03^{a}	2433^{b}	0.85^{b}	81.45^{bc}
summer	6	14.29^{b}	25.24^{a}	2392^{b}	0.81^{b}	91.38^{c}
autumn	6	14.37^{b}	27.56^{ab}	2267^{b}	0.78^{b}	89.08^{c}
refused						
spring	6	10.28^{a}	27.32^{ab}	2226^{b}	0.77^{b}	64.01^{a}
summer	5	12.10^{b}	29.84^{b}	1937^{a}	0.65^{a}	72.64^{ab}
autumn	6	12.99^{b}	29.97^{b}	2020^{a}	0.68^{a}	77.84^{abc}
Animal species (average available + refused grass)						
sheep						
spring	6	11.57^{a}	26.23	2329	0.81	73.13
summer	5	13.09^{ab}	28.52	2117	0.72	80.02
autumn	6	13.46^{ab}	28.94	2107	0.72	81.94
cattle						
spring	6	11.41^{a}	26.12	2331	0.81	72.33
summer	6	13.30^{ab}	26.55	2213	0.74	84
autumn	6	13.90b	28.60	2180	0.75	84.98
Error mean square (DF=23)		1.73	4.69	27082	0.33	91.83

$^{a, b, c}$ $P<0.05$

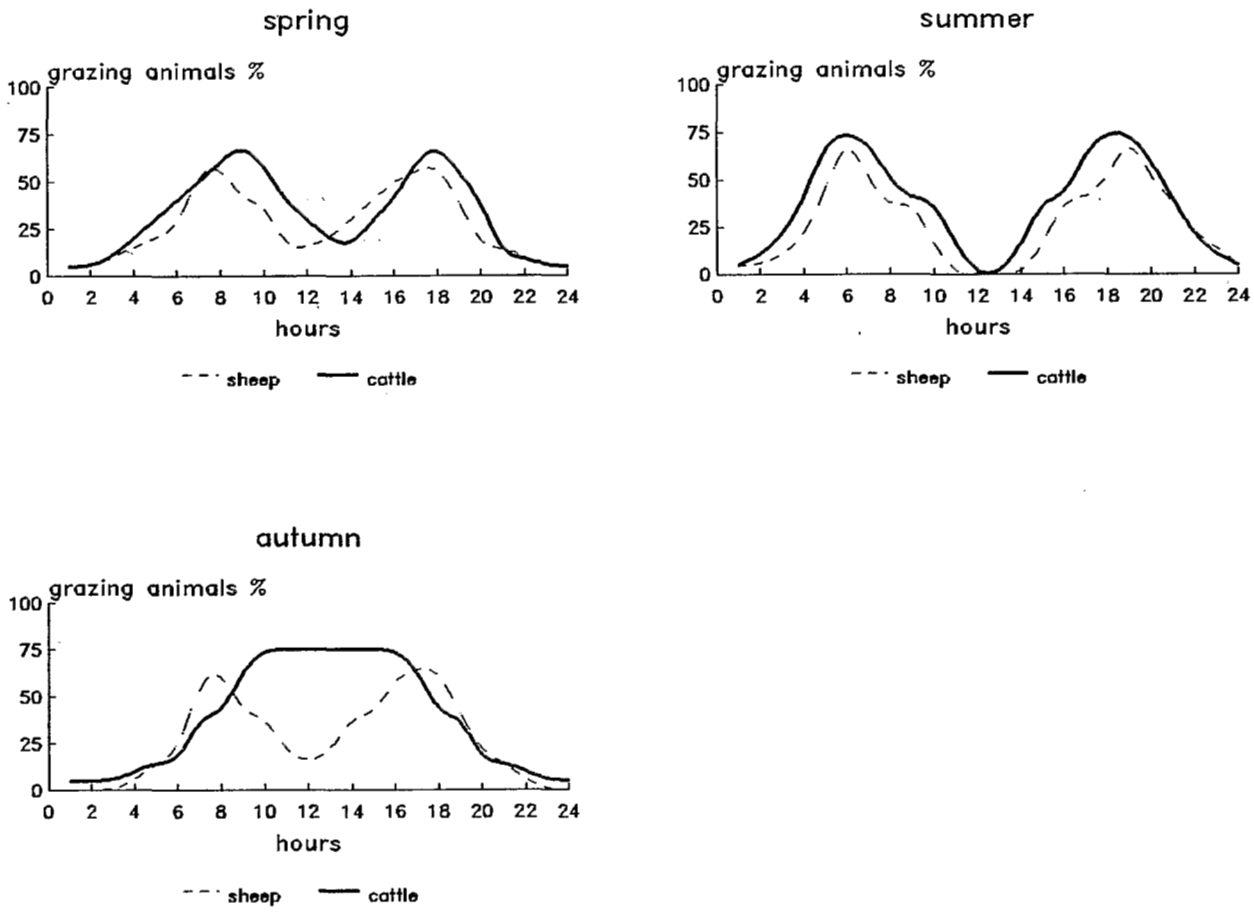

Fig. 4. Grazing time of sheep and cattle in spring, summer and autumn times.

As to utilization rhythm which is strongly conditioned by seasonal trend, grass quality is worst during summer and autumn. During summer, despite the generally higher selective capability of the sheep, cattle were able to consume a better quality fodder, as illustrated by crude fibre and protein in Fig. 5. This is presumably to be ascribed to the wholly strained utilization by cattle during grazing spring cycles, that has reduced the qualitative deterioration linked to the presence of residual stems and senescent tissues.

Conclusions

Sheep and cattle behaviour on a native pasture of the north Ligure-Piemontese Appennine was influenced by several factors (climate, physical environment, vegetation characteristics, animal factors). Among these, climate had most influence on the activities of the two grazing species because of its different implications.

With intensive grazing management and high stocking rate no important differences have been observed in the food selection between the two species. There was a remarkable variability in the degree of selection as a result of different factors,

phenological stage, nutritional level, herbage biomass and a different palatability of herbaceous species) which determined the pasture's utilization degree and vegetational evolution.

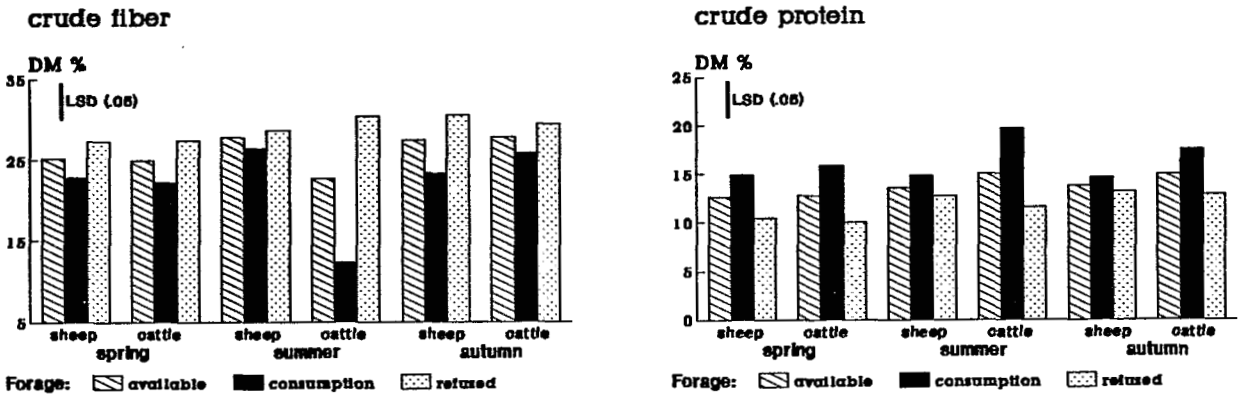

Fig. 5. Effects of season and animal species on the quality (fibre and protein) of available, consumed and refused herbage.

There were some differences in shrub species control between the two species: growth of *Pteridium aquilinum* and *Sambucus ebulus* was reduced by cattle and *Rubus fruticosus* by sheep. Shrubs and some tree species were better controlled by cattle as a result of trampling and breaking of sampling. Sheep were the most sensitive to environmental variations modifying grazing time markedly. They have constantly shown a higher selective capability, in the passage from spring to summer. This has however compromised the sward quality as a result of the high rates of refusal and senescence.

Cattle have effected a more accentuated selection during spring when grass availability was thus keeping a constant level of intake; while during summer and especially autumn, when the grass was lower, they markedly prolonged the feeding period: this behaviour reduced the herbage intake level variations.

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