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Time distribution of activities in the spanish ibex, *Capra pyrenaica*

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RESUME

Répartition journalière des activités du bouquetin d'Espagne, Capra pyrenaica. *Capra pyrenaica.*

L'étude a été faite sur le bouquetin *(Capra pyrenaica)* dans les Sierras de Cazorla et de Segura, au S.E. de l'Espagne. La répartiotion journalière des activités et le budget-temps ont été analysés tout au long de l'année, pendant les heures de jour, pour toutes les classes d'âge et de sexe. On observe deux maximum d'activité, un au lever du jour et l'autre à la tombée de la nuit, avec une période de repos en milieu de journée et en phase pour les trois classes d'âge et de sexe choisis (mâle adulte, femelle adulte et jeune) durant le rut et la période hiver-printemps.

Les mâles ont été séparés en trois classes d'âge et de sexe (vieux mâles, adultes et subadultes). Pendant le rut, ils présentent une distribution des activités comparables à celle des autres individus, mais avec un certain décalage entre eux, probablement pour éviter la compétition.

En ce qui concerne le budget-temps pendant le jour, nous observons que les femelles adultes et les jeunes suivent des stratégies similaires, consacrant plus de temps à l'alimentation pendant l'hiver que durant le reste de l'année. En été, au contraire, le temps passé à se nourrir diminue et la durée des déplacements augmente.

Les mâles ont un comportement différent de celui des femelles et interagissent plus, en particulier durant le rut.

La distribution des activités au cours de la journée entre les mâles pendant le rut varie selon les différentes classes d'âge, identique pour les mâles adultes et vieux, et différent pour les mâles subadultes ; ceux-ci suivent une stratégie plus proche de celle de leurs mères et de leurs frères et sœurs.

Mots clés: Ibex. *Capra pyrenaica.* Rythme d'activité. Budget-temps.

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SUMMARY

The study was carried out on the ibex *(Capra pyrenaica)* which inhabits the mountain ranges of Cazorla and Segura, in Southeastern Spain. The daily distribution of activity and time-budgeting were analysed throughout the year during daylight hours, for each age and sex class. Two peaks of activity were observed — one at dawn and another at dusk — with a rest period at midday, in phase for the age and sex classes (adult males, adult females and juveniles), both during the rutting and winter-spring periods.

The males were classified in three age classes (old males, adults, and subadults). During the rutting period they present a daily distribution of activity similar to that of the remaining individuals, but with a certain phasing out between them, probably to avoid competition.

Regarding time budgeting, it was observed during daylight hours that the adult females and the juveniles follow a similar strategy, spending more time on feeding during the winter than the rest of the year. In summer time spent feeding diminished, and walking increased.

Males behave in a markedly different way from females and juveniles, in all the seasons studied, feeding less than females and interacting more, especially during the rutting period.

Time distribution of activities during daylight hours among males in the rutting period varies according to their age class, this being similar for adult and old males and different from that of subadult males, the latter following a strategy more in the line of their mothers and brothers/sisters.

INTRODUCTION

The way ungulates distribute their time performing the various activities varies with individual age, their sex, reproductive state, social conditions, habitat and season of the year, among other factors (Grubb and Jewell, 1974 ; Boy and Duncan, 1979 ; Turner, 1979 ; Clutton-Brock *et al.*, 1982 ; Alados in press a), the particular pattern shown by the different age and sex classes can be an useful approach to the study of behavioural strategies.

In order to reach conclusions related to these aspects we tried to examine the following topics :

1. Daily distribution of activity of the different age and sex classes during rut and winter-spring periods.

2. Time distribution of activities during daylight hours among the different age and sex classes during rut, winter-spring and spring-summer periods.

METHODS

This study centered on the population of Spanish ibex from the Cazorla and Segura mountain ranges (S.E. Spain).

The observations were made from fixed points for the whole day (dawn to dusk) if the animals were visible all the time, as usually occurs. Binoculars (10 × 40) or a spotting telescope (30 × 70) were used while recording the behaviour of the sample animal.

The three yearly observation periods were :

a) rut (from Nov. 1st. to Dec. 31st., 1982), with a total of 19 observation days and 171 field hours. Data were collected from 7.00 a.m. to 4.15 p.m.

b) winter-spring : the whole winter and first half of spring, until the birth season (Jan. 1st. to Ap. 24th., 1983, and March 16th. to end of Apr., 1982) coinciding with the gestation period, with a total of 20 observation days and 220 field hours. The observation hours were from 7.00 a.m. to 6.15 p.m.

c) spring-summer : including the end of spring and whole summer (May 1st. to Sept. 15th., 1982) coinciding with time of birth and offspring care, with a total of 30 observation days and 390 field hours. Data were collected from 5.00 a.m. to 6.15 p.m.

In total, the data analyzed for the present paper stem from 781 field hours.

The number of animals observed in each period was : 3,376 females, 2,344 young and 2,608 males in the rut period ; 1,865 females, 1,532 young and 953 males in the winter-spring period ; and 1,056 females, 889 young and 868 males in the spring-summer period.

When the daily distribution of activity was analized, the data collected in the spring-summer period were not considered since the animals had a different probability of being observed depending on which behavioural state they were engaged in (standing or resting).

In order to prevent the influence of individuals resting in non visible areas, the time budget was analized taking into account only the active animals (not resting), so, the total time spent standing is taken as 100 %. (Turner, 1979).

The performance of the most frequent activity patterns (resting, feeding, walking, watching and social interactions) as well as sex and age class of the performer were registered. The records for fighting and courtship were kept separately for the adult males. When the individual was involved in a different activity pattern (e.g. scratching) the predominant state immediately after was registered.

The sampling method used was scan sampling (Altmann, 1974), and the diurnal period was partitioned into 15 minute intervals. During each interval a sample was made. This interval was chosen since it gave the observer time to collect the activities of all the ibex and since it has been shown that a ten minute interval gives an accurate estimation of time spent grazing in red deer (Clutton-Brock *et al.*, 1982).

The activities distinguished were :

Lying down : the animal is lying laterally with the head unmoving on the ground and the legs extended or with the sternum on the ground and legs folded under the body.

Walking : including trotting and galloping, the animal shows forward movement, while the head is again above the shoulder-hip axis.

Feeding : the animal is biting, chewing or swallowing food. Feeding overrides walking if both occur simultaneously.

Watching : standing with head raised or moving and looking attentively at its surroundings. It is not considered when the animal interrupts its feeding to lift its head for just a moment.

Social interactions : was the term given to any social activity obviously directed at another group member by any subject during a sampling period.

Courting : includes all courtship activities of males (i.e. : low-stretch, twist, chase, retreat, mounting, see Alados in press b).

Fighting : includes all fighting activities of males (clash, horn-push, butting, agonistic displays, head to tail, shoulder, neck fight and mounting, see Alados in press b).

The criteria for age classes in the field was :

Old males : males older than 8 years or those having a black stripe on the flanks and chest, specially conspicuous in winter.

Adult males : males between 4 and 8 years old, their size is bigger than that of adult females and the black stripe on their flanks is narrower than for old males.

Subadult males : males between 2 and 4 years old, same body size of adult females or slightly bigger ; horns larger and thicker than adult females.

Adult females : horns well developed and maximum body size for females.

Juveniles : including males and females younger than 2 years old, with both horns and body size smaller than adult females.

The correlation cœfficients between the daily distribution of activity by the individual classes (after arcsin transformation) were calculated and the significance of the correlation cœfficients was tested.

The differences between age and sex classes or period of year were tested using the Mann-Whitney U test.

RESULTS

The distribution of active animals (not lying down) during daylight is represented in *figure 1*, where a higher tendency to rest during the

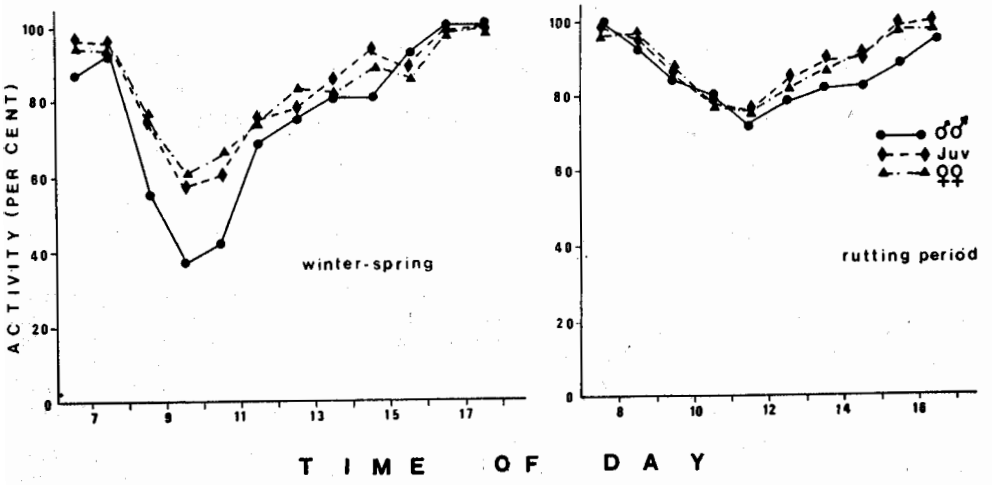

Fig. 1 : *Distribution of activity during daylight hours of the different age and sex classes. In ordenates we represent the frequency (per cent) of individuals active in each hour.*

Fig. 1 : *Distribution journalière des activités durant le jour pour les différentes classes d'âges et sexe. Les ordonnées représentent la fréquence (pour cent) du nombre d'individus actifs à chaque heure.*

winter-spring period is evident, although not significantly different from the rutting period ($U = 48.5$, $n_1 = 10$, $n_2 = 12$, N.S. for females ; $U = 45.5$, $n_1 = 10$, $n_2 = 12$, N.S. for youngs ; $U = 46$, $n_1 = 10$, $n_2 = 12$, N.S. for males ; Mann-Whitney U test). Here also, and contrasting with the low level of activity before noon, we can observe high values of activity at dawn and dusk during both study periods and for all classes of individuals *(table I)*.

In *figure 2* we represent the daily activity variation for the different male age classes during rut. Although the three classes are very similar in this respect, they are out of phase to some degree, a higher variation range being evident in the case of the subadults *vs.* old males *(table II)*.

Table I : *Comparisons of daily distribution of activity between classes of individuals (after arcsin transformation).*

Tableau I : *Comparaisons de la distribution journalière d'activité entre les classes d'individus (après transformation arcsin).*

Period	Classes	Correlation cœfficients	P
Rut	Adult female *vs.* young	0.970	0.001
«»	Adult female *vs.* adult male	0.804	0.01
«»	Young *vs.* adult male	0.820	0.01
Winter-Spring	Adult female *vs. young*	0.985	0.001
«»	Adult female *vs.* adult male	0.962	0.001
«»	Young *vs.* adult male	0.954	0.001

Table II : *Comparisons of daily distribution of activity between male age classes (after arcsin transformation) during rut period.*

Tableau II : *Comparaison de la distribution journalière d'activité entre les classes d'âge des mâles (après transformation arcsin) pendant le rut.*

Classes	Correlation cœfficient	P
Subadult males *vs.* adult males	0.726	0.01
Adult males *vs.* old males	0.789	0.01
Subadult males *vs.* old males	0.614	0.05

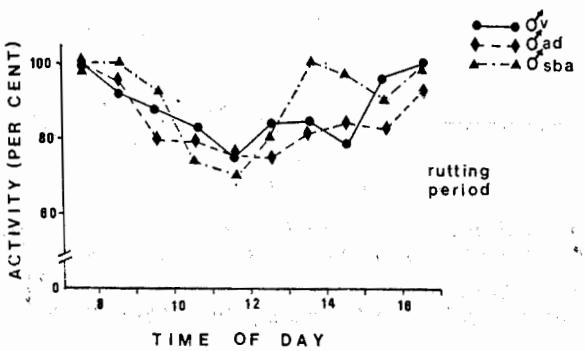

Fig. 2 : *Distribution of activity during daylight hours of the different male age classes during rut. In ordenates we represent the frequency (per cent) of individuals active in each hour.*

Fig. 2 : *Distribution journalière des activités durant le jour pour les différentes classes d'âge de mâles durant le rut. Les ordonnées représentent la fréquences (pour cent) du nombre d'individus actifs à chaque heure.*

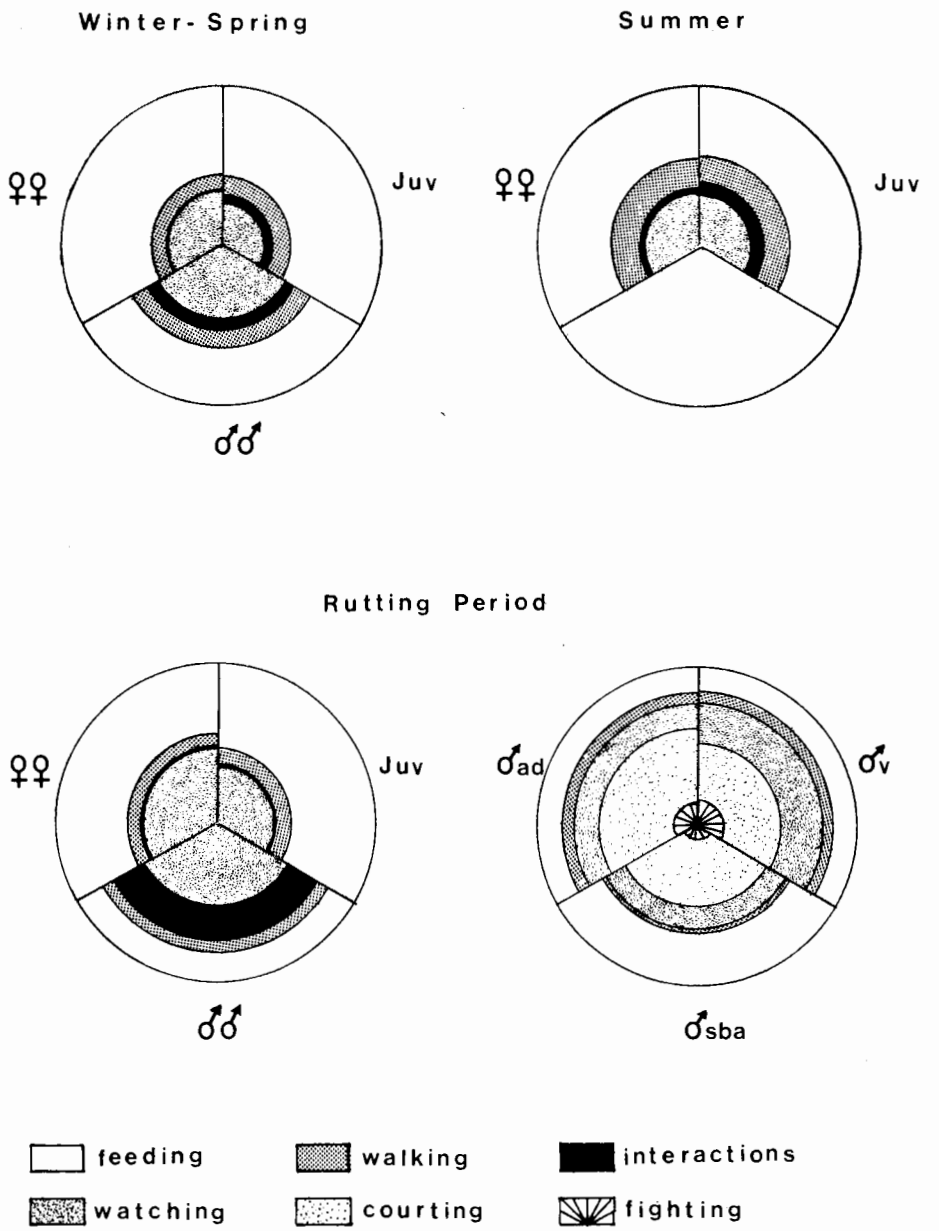

Fig. 3 : *Time budget during daylight hours when the animals are standing for each individuale class and for the various observations periods.*

Fig. 3 : *Budget-temps pendant le jour en position debout pour chaque type d'individu et pour les différentes périodes d'observation.*

Of the total time spent standing, the portion dedicated to each activity by each individual class and for the various observation periods is represented in *figure 3*, the results also being shown in *appendices I to III*.

At first we compared the time-budget during daylight hours between different periods of the year. We have to be careful with these comparisons since in summer we could observe the ibex feeding before dawn on moon-lit nights.

Starting with the adult females, they shown a tendency to feed more in winter-spring than during rut and summer, no clear difference being found between the latter two periods. The time dedicated to walking by this class is higher in summer than for the other two periods, no significant difference being found between rut and winter. The level of interactions is low for the adult females in all seasons, being higher in summer than during rut, and higher during this period than for winter-spring. No significant difference was found in the time dedicated by this class to vigilance (watching) during the three yearly periods (*Appendix I*).

The juveniles, as well as the adult females, feed less in summer than during winter-spring and rut showing the opposite tendency with respect to walking, whereas the time dedicaced by them to vigilance (watching) is higher during rut than for the winter-spring period. The level of interactions is also low for this class in all periods, no significant difference being found among them (*Appendix I*).

As for the adult males, a low level during rut as compared to winter-spring was found for feeding and interactions, whereas no significant differences were found in the time dedicated to walking and vigilance (*Appendix I*).

If we now compare the time distribution of activities during daylight hours between sex and age classes, we observe that in the winter-spring period, the differences between the three age classes are not very obvious. The difference between adult females and juveniles is based on the time dedicaced to interactions, this being greater in juveniles. The adult males spent less time feeding than adult females and juveniles. On the other hand, the time dedicated to walking is greater in adult *vs.* juveniles and in adult males *vs. females.* The time spent on interactions does not vary significantly between adult males and juveniles, although it does vary between adult males *vs.* adult females. Finally, the adult males and females watch more than the juveniles (*Appendix II*).

During the summer, not enough data concerning adult males were collected, therefore we shall compare only adult females and juveniles. The time budget in adult females and juveniles during daylight hours differs little in summer. Only the time dedicated to interactions is somewhat greater in juveniles than in females, although not statistically significant ($p < .1$). (*Appendix II*).

During rutting, *fig. 3*, the adult females and juveniles divide their

Appendix I. *Time budget comparisons during daylight hours between periods of the year (Mann-Whitney U test).*

Appendice I : *Comparaison des budgets-temps pendant les heures du jour selon les périodes de l'année (Test U de Mann-whitney).*

Class	Period	Activity	U	n_1	n_2	P	Significance level
Adult female	Rut *vs.* winter-spring	Feeding	28.5	10	12	0.05	*
	— —	Walking	48	10	12	N.S.	
	— —	Interactions	27	10	12	0.05	*
	— —	Watching	31	10	12	N.S.	
	Winter-spring *vs.* summer	Feeding	33	12	14	0.02	**
	— —	Walking	10	12	14	0.002	***
	— —	Interactions	80	12	14	N.S.	
	— —	Watching	71.5	12	14	N.S.	
	Rut *vs.* summer	Feeding	66	10	14	N.S.	
	— —	Walking	7	10	14	0.002	***
	— —	Interactions	35.5	10	14	0.05	*
	— —	Watching	37	10	14	N.S.	
Young	Rut *vs.* winter-spring	Feeding	54.5	10	12	N.S.	
	— —	Walking	41	10	12	N.S.	
	— —	Interactions	53	10	12	N.S.	
	— —	Watching	27	10	12	0.05	*
	Winter-spring *vs.* summer	Feeding	20	12	14	0.002	***
	— —	Walking	45	12	14	0.05	*
	— —	Interactions	74	12	14	N.S.	
	— —	Watching	54	12	14	N.S.	
	Rut *vs.* summer	Feeding	17	10	14	0.002	***
	— —	Walking	27.5	10	14	0.02	**
	— —	Interactions	60.5	10	14	N.S.	
	— —	Watching	61	10	14	N.S.	
Adult male	Rut *vs.* winter-spring	Feeding	15	10	12	0.02	**
	— —	Walking	47.5	10	12	N.S.	
	— —	Interactions	10	10	12	0.002	***
	— —	Watching	45	10	12	N.S.	

Appendix II : *Time budget comparisons during daylight hours between classes of individuals (Mann-Whitney U test).*

Appendice II : *Comparaison des budgets-temps pendant les heures du jour entre classes d'individus (Test U de Mann-Whitney).*

Period	Classes	Activity	U	n_1	n_2	P	Significance level
Rut	Adult female *vs.* young	Feeding	24	10	10	N.S.	
	— —	Walking	28	10	10	N.S.	
	— —	Interactions	18	10	10	0.02	**
	— —	Watching	24	10	10	N.S.	
	Adult female *vs.* adult male	Feeding	1	10	10	0.002	***
	— —	Walking	19	10	10	0.02	**
	— —	Interactions	0	10	10	0.002	***
	— —	Watching	32	10	10	N.S.	
	Young *vs.* adult male	Feeding	0	10	10	0.002	***
	— —	Walking	5.5	10	10	0.002	***
	— —	Interactions	0	10	10	0.002	***
	— —	Watching	11	10	10	0.02	**
Winter-Spring	Adult female *vs.* young	Feeding	68	12	12	N.S.	
	— —	Walking	63	12	12	N.S.	
	— —	Interactions	17	12	12	0.002	***
	— —	Watching	34	12	12	0.05	*
	Adult female *vs.* adult male	Feeding	19	12	12	0.002	***
	— —	Walking	29	12	12	0.02	**
	— —	Interactions	16	12	12	0.002	***
	— —	Watching	38.5	12	12	N.S.	
	Young *vs.* adult male	Feeding	15	12	12	0.002	***
	— —	Walking	36	12	12	0.05	*
	— —	Interactions	41.5	12	12	N.S.	
	— —	Watching	19	12	12	0.002	***
Summer	Adult female *vs.* young	Feeding	71	14	14	N.S.	
	— —	Walking	96	14	14	N.S.	
	— —	Interactions	56.5	14	14	N.S.	
	— —	Watching	86	14	14	N.S.	

Appendix III : *Time budget comparisons during daylight hours between the male age classes (Mann-Whitney U test).*

Appendice III : *Comparaison des budgets-temps pendant les heures de jour entre les mâles de différentes classes d'âge (Test U de Mann-Whitney).*

Classes	Activity	U	n_1	n_2	P	Significance level
Old male *vs.* adult male	Feeding	39.5	10	10	N.S.	
— —	Walking	50	10	10	N.S.	
— —	Watching	29.5	10	10	N.S.	
— —	Courtship	23.5	10	10	N.S.	
— —	Fighting	45.5	10	10	N.S.	
Old male *vs.* subadult male	Feeding	14	10	10	0.02	**
— —	Walking	31	10	10	N.S.	
— —	Watching	14	10	10	0.02	**
— —	Courtship	33	10	10	N.S.	
— —	Fighting	33.5	10	10	N.S.	
Subadult male *vs.* adult male	Feeding	16	10	10	0.02	**
— —	Walking	30.5	10	10	N.S.	
— —	Watching	24	10	10	N.S.	
— —	Courtship	22	10	10	0.05	*
— —	Fighting	37	10	10	N.S.	

time in a similar way, which differs from adult males. Only the time spent on interactions differs significantly between adult females and juveniles, being greater in the latter. The time dedicated to feeding is significantly greater in adult females and juveniles, in comparison with the adult males. On the other hand, time spent on interactions is much greater in adult males *vs.* adult females and adult males *vs.* juveniles. The juveniles watch significantly less than the adult males and less than the adult females, although this latter difference is not significant. Walking is less frequent in adult males than adult females and juveniles (*Appendix II*).

In the case of males, it is easily observed that the old males and adult males divide their time in a similar way, different to the time-budgeting of the subadults. The subadult males feed more than the adult and old males. The subadult males court less than the adults and to the same extent as the old males, while the old males watch more than the subadults.

DISCUSSION

The pattern of activity of the ibex of Cazorla is very similar to that found for the same species in Central Spain (Gonzalez, 1982) during the rutting period, for the makhor (Schaller and Mirza, 1971) and in general for all Caprinæ species (Schaller, 1977). Apparently, there is a greater tendency to rest during daylight hours in summer, both in the Spanish ibex (Gonzalez, 1982) and the Alpine ibex (Schaerer, 1977).

Concerning the daily distribution of activity of the different male age classes during the rutting period, our interpretation is that the phasing out among these individuals is probably due to the necessity of avoiding contacts, which would lead to possible aggression, especially during this period when they have to compete not only for food, but also for the females. This has already been demonstrated in various species of vertebrates, where the subordinates avoid contact with the dominant members, carrying out their activities at different times Crowcroft and Rowe, 1963 ; Crowcroft, 1966 ; Pöppel, 1968 ; Bovet, 1972 ; Simon and Middendorf, 1976 ; Regal and Conolly, 1980 : Alados in press a).

The fact that the adult females spend more time feeding during winter-spring than the rest of the year, is probably due partly to the fact that winter-spring corresponds to the gestation period, and partly to the fact that in the winter the poor quality of the food and the increased cost of thermoregulation (Moen, 1973) make it necessary for the animal to feed for a longer time in order to obtain the same amount of energy ; this also occurs in the roe deer (Turner, 1979) and red deer (Clutton-Brock *et al.*, 1982). However it is necessary to take into account that in summer the animals are more active at night (personal observation), and may be there was no change in daily feeding time.

On the other hand, during summer, the females spent more time walking, and this can be explained by the fact that there is a greater quantity of food available, and the individual can devote part of its time to searching for the best food and sources of water.

The juveniles follow the same strategies as their mothers regarding time budgeting, which is probably explained by the fact that the young and females live together and they syncronize their activities.

In the case of the adult males, like the adult females and juveniles, they spend more time feeding during the winter-spring period than during the rutting period, which can be interpreted as being due to in the latter period, the males being so involved in rut that they eat less than they require, causing a state of starvation at the end. The time devoted by adult males to interactions during rutting is very great, as is the norm in the adult male ungulates (Schaller, 1977 ; Turner, 1979 ; Clutton-Brock *et al.*, 1982 ; Jingfors, 1982).

As far as the males of different ages are concerned, and centering our attention on the most mature ones, since the subadults are still, to a certain extent, in the class of the juveniles, the fact that the adult males dedicate more time to courtship than the old males, may be due to the efficient courtship of the old males not being so active as that of the adult males, since frequently their attitude is only one of placing themselves behind the female in heat, preventing the approach of other males, and occasionally showing courtship behaviour. In addition, if we add the time dedicated to watching (greater in the old males than in the adult males) to the time dedicated to courtship, we see that no differences exist between one group and another.

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