AN ANALYSIS OF MOTHER-YOUNG BEHAVIOUR OF FALLOW DEER
DURING LACTATION PERIOD

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Abstract. In the Doñana National Park (SW Spain) female fallow deer (*Dama dama*) give birth during the first fortnight of June, the next breeding season starting at the beginning of October. Between these two events the most important part of lactation takes place. Daily observations were made during the summer of 1984 and 1985. The population studied was made up of fourteen mother-young pairs that we were able to recognize individually. During each sampling period a pair of mother-young was scanned. Activities were categorized as follows: feeding, walking, selfgrooming, vigilance, mother-young interactions, and social interactions. No differences were observed in the ontogeny of behaviour neither between male and female fawns nor between their mothers. However, analysing individual differences there appeared a variation between mothers in relation to the rate of interactions towards their fawns, which was in positive correlation with the fawns weight in the case of males. Our results also suggest the possibility of higher investment in heavier female fawns. Furthermore, there is an annual variation in the maternal behaviour in relation to the availability of resources.

Keywords: maternal behavior, parental investment, fallow deer

INTRODUCTION

Births of fallow deer (*Dama dama*) in Doñana are highly synchronized and take place during the first two weeks of June (Braza et al., in press). Females spend most of their time by day far from the fawns which remain hidden during the first two weeks of their lives; their mothers seek them out a few times a day to nurse and groom them. The integration process of females and their fawns in matrilineal groups takes place two weeks after birth.

Over summer months mothers and fawns live in matrilineal groups, and during this period the most important part of lactation takes place. At the beginning of autumn (with the proximity of the rut in October) the males join the female groups, and mother and offspring interest may be in conflict: conflict over the time the mother is willing to invest in the young and the time demanded by **it**, since the female must face the next reproduction.

The parental investment theory proposes several hypotheses about the expected sex differences in mother-offspring relationships. According to Trivers (1972), parental investment is defined as anything done by the parent that increases its **offsprings** chances of survival and reproduction while decreasing the parents ability to invest in other offspring.

Among polygynous males, which presumably **are** subjected to strong sexual competition, body size is very important since the reproductive success of a male is closely related to its dominance (Clutton-Brock and Harvey, 1978). In deer there is some evidence that reveals the importance of growth during the first summer of life for the size and physical condition of the adult individual (Clutton-Brock et al. 1982, Skogland, 1983). Then, if a males body condition is strongly influenced by maternal investment during the first months of life, parents should invest more intensively in their sons than in their daughters during this period (Reiter et al., 1978, Dittus, 1979, Maynard Smith, 1980, Clutton-Brock and Albon, 1982).

There is some information about sexual differences in growth and development of polygynous species (reindeer: Krebs and Cowan,

B tauow oeer: rzywinsky et al., 1977; grey seals: Mnoerson and Fedak, 1987) and in all cases male fawns grew faster than female ones.

in free ranging fallow deer. The present study tries to analyse the mothers and the fawns behaviour during the first summer of the fawns life, with special emphasis on the influence of the fawns sex to test our results with respect to the proposed hypotheses about parental investment.

METHODS

The following study was carried out in the Biological Reserve of the Biological Park (W of Snin' L. In this area, the fallow deer population is concentrated in an ecotone zone situated between the shrub and the marshland (Braza, 1975).

During the two summers, observations were recorded. The population studied consisted of 14 pairs of mother and young (6 males and 8 females). There were 2 males and 5 females in 1984 and 4 males and 3 females in 1985.

The fawns were marked with plastic ear tags just after birth whereas their mothers were recognized by the different patterns of their coats. In addition, the fawn's sex, birth date, weight and six other measurements were recorded (Braza et al., in press.).

The observations were carried out from a tower 3Dm high by use of telescope.

During each sampling period, lasting 15 min, a mother-young pairs behaviour was scanned (Altmann, 1974) at 30 s intervals. The mothers and fawns activities were categorized as follows:

- Feeding: including grazing and drinking.
- Walking: including any change of site with head erect.
- Lying: including any change of site with head down.
- Selfgrooming: including licking any region of ones own body.
- Mother-young interactions: including all activities of maternal care and of mother-young affiliating relation (allogrooming, approach to the fawn/mother, suckling...).
- Social interactions: including all activities which imply communication of mother or fawn with another individual.

Mother-fawn pairs were selected at random for scanning sessions. Record were made mainly in the hours corresponding with the periods of maxim activity, i.e. at sunrise and at sunset. During the night we did not record since the individual identification was practically impossible. The observation time totalled 354 hours which correspond to 1415 periods of data recording, distributed among the fourteen pairs of mother and fawn considered. There is no data from the first fortnight since the young remain hidden and few observations were made.

Differences between individuals, sexes and years were examined using an Analysis of Variance (bmdp computer program *P1D*, Dixon, 1979). The arcsine transformation was applied to percentage data from scan.

Though we know the statistical problem that the point samples in each record period of 15 mm cant be totally independent, we think the effect is not too important since our results aim to establish comparative relations between the different variables considered; except in highly artificial laboratory studies, few biological data will be entirely free from this effect, and we think our samples should be large enough. In any case, as regards this problem, we have considered a level of confidence of $p < 0.01$ to the significance of the results.

RESULTS

In both years, 1984 and 1985, there didnt appear significant individual differences.

However, as can be seen in table 1, there were two female fawns in 1984 which weight was significantly higher than that of the rest of the female fawns ($p = 0.0012$). Comparing the behaviour of these two different fawns with the rest of females it is interesting that they showed a higher percentage of interactions towards their mothers and besides their mothers showed a higher percentage of vigilance (Table 2).

Comparing the behaviour of mothers and fawns in relation to the fawns sex, activities didnt differ significantly neither in 1984 nor 1985.

TABLE 1

Birth measurements of female fawns born in 1984 (BD=body length, TL=tail length, HCG=half of chest girth, SH=shoulder height, FL=foot length, EL=ear length, W=weight).

FAWN	BIRTH			MEASUREMENTS			
	BL	TL	HCG	SH	FL	EL	W
F2	680	100		400	220	85	4800
F6	671	101	180	428	212	78	4550
F10	693	91	169	485	210	89	4800
F30	695	101	165	477	227*	82	6200*
F32	665	102	180	493	231*	85	6400*

TABLE 2

Differences in birth measurements and behaviour between female fawns born in 1984 (Analysis of Variance).

		F2,6,10	F30,32	level of significance
WEIGHT	X	4716.66	6300.00	p=0.0012
	SD	144.33	141.45	
FAWN INTERACTIONS TOWARDS HER MOTHER	X	5.87	2.09	p=0.0037
	SD	8.56	2.64	
VIGILANCE FROM THE MOTHER		5.04	1.63	p=0.0037
	SD	7.10	1.92	

Analysing the whole sample (1984+1985) there was no individual variation between fawns; both mothers of male and mothers of female showed individual differences in the percentage of interactions towards their fawns ($p=0.0027$ for males mothers and $p=0.001$ for

females mothers). For mothers of male fawns this rate of interactions was in positive correlation with the fawns weight, whereas there was no any correlation found in the case of females mothers (Table 3).

TABLE 3

Analysis of correlation between the fawns weight and the percentage of interactions towards them showed by their mothers.

MALE FAWN			FEMALE FAWN		
	weight	t interac.		weight	% interac.
F1	6500	3.59	F32	6400	5.07
F73	6100	2.23	F30	6200	4.43
F5	5400	3.51	F52	5000	0.58
FS5	5300	3.28	F10	4800	3.67
F53	5000	1.25	F2	4800	3.85
FS1	4500	0.90	F6	4550	3.85
			F54	4400	1.44
$r=0.8285; p=0.05$			$r=0.5267; N.S.$		

Since individual variation appeared considering the whole sample, but not in each particular year sample, we can think of variations between individuals of different years. For this analysis we have considered the male and female classes for both mothers and fawns. In this sample we have excluded the two higher female fawns (and their mothers) since they showed significant differences with respect to the rest of females samples.

As to fawns, there were significant differences between 1984 and 1985 in the percentage of interactions with other individuals for both male ($p=0.0095$) and female ($p=0.0035$) (Fig.1). Moreover female fawns also showed differences in the activities of

Fig. 1. Variations in the percentage of interactions with other individuals showed by fawns during 1984 and 1985 summers.

Fig. 2. Variation in the percentages of Jocomotion and vigfiance showed by female fawns during 1984 and 1985 summers.

Fly 3. Variation *in* the percentage of Thteractions showed by mothers of both sexes fawns during 984 and 1985 summers.

locomotion and vigilance ($p=0.0022$ and $p=0.0024$ respectively) (Fig.2)

Considering mothers, in both cases (malesmothers and females mothers) appeared significant differences between years in the rate of interactions towards their fawns ($p=0.0126$ and $p=0.0000$ respectively) (Fig.3).

DISCUSSION

In polygynous species where male reproductive success is partly determined by body size, it would be an advantage for mothers to invest intensively in male offspring (Clutton-Brock and Albon, 1982; Maynard-Smith, 1980, Reiter et al., 1978).

In the case of the fallow deer in Doñana no differences were observed in the ontogeny of behaviour between male and female fawns (neither between their mothers) as either have been found for other polygynous species (Kovacs, 1987).

However, in a previous study about the same fallow deer population Braza et al. (in press.) found a higher maternal investment before birth in male fawns than in female ones. Thus, male fawns are born heavier and bigger than females and showed a tendency to be born earlier in the season.

The parental investment theory predicts that offspring which is born heavier maintains this relative advantage up to weaning. We could expect a higher allocation of nutrients from the mother towards male fawns than towards female ones during the lactation period. Thus, males also seems to have an intrinsic potential to

grow faster and larger than females (Anderson and Fedak, 1987; Krebs and Cowan, 1962; Krzynwinsky et al., 1984), which is realized when resources are available (Gosling et al., 1984).

Analysing individual differences there appeared a variation between mothers in relation to the rate of interactions towards their fawns, which was in positive correlation with the fawns weight in the case of males. That could suggest that the body condition of a male fawn influence his mothers behaviour inducing a higher investment in heavier fawns.

Though there wasnt found any relation between the rate of interactions from mothers towards their daughters and the female fawns weight, our result point out the possibility of a higher investment in heavier female fawns since the mothers of those two heavier female fawns born in 1984 showed a higher level of vigilance than the rest of the sample.

The prediction that mothers invest more in males than in females does not exclude the possibility that there could sometimes be fitness benefits from investing in large female offsprings. As Gosling et al. (1984) point out, selection might have favoured relatively high investment in large males offspring and high investment in large females could be a consequence of the same mechanism.

From the analysis of the annual variation the results showed a higher rate of interactions towards the fawn by mothers of fawns of both sexes in 1984 and 1985. Besides, fawns of both sexes showed higher percentage of interactions with other individuals in 1985.

Since the size and the weight of both years fawns were not different, there were probably some environmental factors influencing mother and fawn behaviour. We have no data about

Doñana, where the availability of resources directly depends on rain fall, and this factor supports important fluctuations between years, we could expect a flexibility in maternal investment depending on variation which affects both mother and fawn body condition, as has been pointed out by other authors (Berger, 1979, McClure, 1981, Gosling, 1984).

One can also expect these fluctuations to affect the fawns behaviour. Since the offspring isn't a passive vessel into which the parents pour their care, we must imagine an offspring attempting to maximize its reproductive success, so it would presumably want more investment than the parent is selected to give (Trivers, 1974). Such parent-offspring conflict corresponds to weaning in mammals.

In conclusion, for the fallow deer of Doñana, though there are not any significant sexual differences in the behaviour neither of mothers nor of fawns, the detected individual variation suggests a relation between the fawns weight at birth and the maternal care, so that a high maternal investment might permit them to

Besides, fallow deer show an adaptation flexibility to the annual variation according to that established by the parental investment theory about the influence of resource availability in the mother's behaviour during the lactation period.

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