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PARTURITION DATES AND MOTHER-KID BEHAVIOR IN SPANISH IBEX (*CAPRA PYRENAICA*) IN SPAIN

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Postpartum behavior of domestic and feral goats (*Capra hircus*) has been documented (Coblentz, 1974; Hafez and Scott, 1962; Klopfer and Klopfer, 1968; Lickliter and Heron, 1984; O'Brien, 1983, 1984; Rudge, 1970) but relatively little is known about maternal behavior of wild ibex (Couturier, 1962; Lent, 1974; Nievergelt, 1974; Schaller, 1977). The purpose of this study of the Spanish ibex, *C. pyrenaica*, was to investigate timing of birth at two locations in Spain, and to describe mother-young interactions and surveillance for predators.

Mothers and kids were observed in two mountainous areas in the southeastern Iberian Peninsula, the Cazorla-Segura mountains, and eastern Sierra Nevada. The Cazorla-Segura mountains are located 37°45′–38°10′N, 2°40′–3°00′W. These mountain ranges are limestone substrate with a maximum elevation of 2,107 m. Annual precipitation is 1,000–1,600 mm. Major tree species in this area are *Pinus nigra*, *P. pinaster*, *P. halepensis*, and *Quercus ilex*. The Sierra Nevada is the highest range in the Iberian Peninsula rising to a maximum of 3,482 m. Our study area was in the eastern part of these mountains where the highest peak is 2,609 m; these mountains lie 37°08′–37°02′N, 2°60′–3°02′W. Average annual precipitation is approximately half that of the Cazorla-Segura mountains. The highest, central part of this mountain range is flat and rounded with schist forming the geological structure, whereas the lower and steeper peripheral zones are composed primarily of limestone and sandstone. Our study area was characterized by schist. Alpine meadows (*Genista baetica*, *Erinacea anthyllis*, and *Festuca clementei*) predominate above 2,200 m, whereas *P. silvestris* is the major species at lower elevations.

The population density of ibex is higher in Cazorla-Segura mountains (0.13 ibex/ha) than in the eastern Sierra Nevada (0.029 ibex/ha). Other large wild mammals in the Cazorla-Segura mountains are fallow deer (*Dama dama*), red deer (*Cervus elaphus*), and mouflon (*Ovis ammon*); these species do not inhabit the Sierra Nevada.

Daily censuses of ibex were obtained on 26 days between 23 April and 30 June 1984 in Cazorla-Segura mountains and on 11 days between 20 April and 5 June 1985 in the eastern Sierra Nevada. During daily censuses the following data were recorded: group size and composition, individual activity, and reproductive condition of females (pregnant, lactating, or barren). Additionally, 57 h of observation were conducted in the Cazorla-Segura mountains during which we recorded, at 1-h intervals, the estimated distance (to the nearest 5 m) to the nearest neighbor within the group, behavioral activity, and position (peripheral or central) of all group members. An animal was considered to be central if it was inside an area circumscribed by lines joining the outlying animals in the group and to be peripheral if it was one of the outlying animals (Clutton-Brock et al., 1976). Records were not made for groups smaller than five animals because of the bias toward being peripheral in small groups. In addition, at each 1-min interval we recorded the activity of the mother and her offspring (scan sampling; Altmann, 1974). As a measure of adult female altertness during feeding, we counted the number of head lifts during 1-min intervals. Whenever social interactions between mother and kid occurred, records were made of the frequencies of approaches between mother and kid and the durations of suckling and licking bouts. We witnessed births of three kids subsequently identifiable individually by body features. For the remaining kids we estimated their age to the nearest week by comparison of their stage of development with that of the known-aged kids.

Based on data collected by censuses and following Caughley (1977), we calculated the "peak period" of birth in the ibex population in the Cazorla-Segura mountains, by dividing the interval from the first to the last parturition into equal 1-week periods and noting the percentage of births occurring in each week. The first of 43 births in the Cazorla-Segura mountains occurred on 7 May 1984. The parturition season was divided into four 1-week periods commencing with 7 May; 4, 10, 20, and 6% of females in the population gave births in these weeks. Females rarely gave birth later than the 1st week of June. Thus, we assume that only 40% of females produced young. The average $\pm SD$ parturition date was 22 May $\pm$ 6 days (n = 43).

In the eastern Sierra Nevada the first birth was observed on 15 May 1985. The birth season was divided

TABLE 1.—*Activity of female Spanish ibex according to whether her kid is standing or resting.*

Behavior of kid	Behavior of mother			Min observation of kid
	Watch	Lie	Feed	
Stand	116	22	251	389
Lie	33	182	196	411
Min observation of mother	149	204	447	800

into three 1-week periods beginning with 15 May; 18, 60, and 0% of females gave birth in these weeks. The rate of reproduction was higher in this area (78% of females produced young) than the Cazorla-Segura mountains. The average $\pm SD$ parturition date was 25 May $\pm$ 3 days (n = 14).

A second method was used to calculate the average birth date for ibex in the Cazorla-Segura mountains. The numbers of females that were pregnant or lactating was determined daily from 8 May to 1 June. Probit analysis (Caughley, 1977) gave a mean date of parturition of 18 May $\pm$ 23 days. Thus, the two methods gave a similar mean birth date for the population of Cazorla-Segura mountains. Gestation, the interval between 4 December when peak mating occurred (Alados, 1986) and 20 May, was estimated to be 23–24 weeks. This period is similar to that for feral goats reported by Bonham and Fairley (1984) but longer than that oberved by Mackenzie (1980).

For three mother-offspring pairs observed in Cazorla-Segura mountains for a total of 2.73 h during the first 2 days after birth, the mother stayed within 5–15 m of the offspring. Subsequent observations showed that as kids grew older, they became more independent, but still remained close to their mothers. Of 229 observations of 1-h intervals of 2- to 3-week-old kids, mothers were <5 m away from the kid 196 times, 5–14 m away 29 times, and ≥15 m away 4 times. Of 161 observations of distances between adult females, females were observed <5 m apart on 56 occasions, 5–14 m apart on 66 occasions, and ≥15 m apart on 39 occasions. These distribution patterns differ significantly (χ^2 = 112.24, $d.f.$ = 2, $P < 0.001$), indicating a closer association between mothers and kids than between adult females.

The female must minimize the chance that her kid will be caught by predators but at the same time ensure that it will grow rapidly before winter. A strategy used by the mother to enhance survival of her offspring is isolation in inaccessible areas during parturition which decreases chances of predation on the female and neonate (Couturier, 1962; O'Brien, 1983). Another strategy is increased vigilance on the part of the mother, particularly when the neonate is standing rather than lying down. When the kid was standing the mother was significantly more likely to be watching (29.8% of 389 observations) than when the kid was lying (8.0% of 441 observations; χ^2 = 46.2, $d.f.$ = 1, $P < 0.001$; Table 1). This situation also has been recorded in red deer (*Cervus elaphus*; Clutton-Brock et al., 1982). The behavior of mother and kid was synchronized. When the mother was lying down the neonate was generally lying (χ^2 = 125.5, $d.f.$ = 1, $P < 0.001$), although the reverse was not true because of the longer resting period of the neonate (Table 1).

Peripheral animals in a herd are those most frequently taken by predators (Hamilton, 1971), so kids might be expected to be located in the center of maternal groups. Of 226 observations of females, 155 were peripheral and 71 central, whereas of 199 observations of kids, 74 were peripheral and 125 central. A contingency table revealed that kids were significantly more likely to be centrally positioned than females (χ^2 = 41.99, $d.f.$ = 1, $P < 0.001$).

Finally, we analyzed the incidence of vigilance (number of head lifts during 1-min periods) by pregnant and lactating ibex femlaes according to the number of kids and females in the group (Fig. 1). Both showed a negative relationship between group size and mean rate of vigilance ($r_s = -1$, n = 4, $P < 0.05$ for pregnant females, $r_s = -1$, n = 4, $P < 0.05$ for lactating females, where n is the number of size classes considered).

Females in late gestation were more vigilant than lactating females when in groups of two (z = 2.13, P = 0.016). We suggest that pregnant females are less agile at this time, hence more vulnerable to predators. Relative to lactating females, mean vigilance rate of pregnant females decreased more steeply with increasing group size. Because kids in a large maternal group interact frequently, rendering them more visible to predators, lactating females should be more vigilant than pregnant females. Furthermore, pregnant females in big groups are not near parturition and are less vigilant than near-term females. However, vigilance rates differend significantly only for groups of two animals.

Growth rate of kids during the first 3 months of life probably is the principal determinant of the size at which they enter the winter and is likely to affect both their chance of survival and body size as adults. During the first days after birth there is intensive contact and interaction between mother and offspring, with kids sucking 3.3 times/h (2.73 h observations). After a week or so, sucking frequency decreased to 1.6 times/h (54.33 h observations). The duration of sucking bouts decreased from 77.1 $\pm$ 54.2 s (n = 9) to 26.5 $\pm$

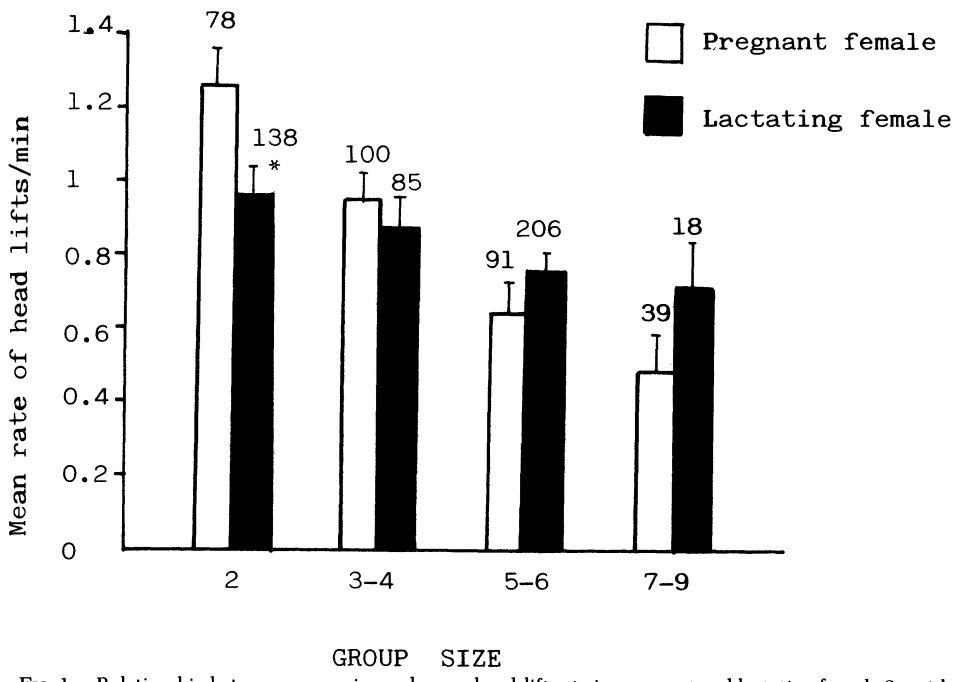

FIG. 1.—Relationship between group size and mean head-lift rate in pregnant and lactating female Spanish ibex. Sample size is shown above each historgram; lines show +*SE* (* indicates $P < 0.05$ for pregnant versus lactating females).

17.7 s ($n = 73$). Thus, young ibex nursed less often and for shorter periods as they aged, as has been reported by Lent (1974) for several ungulate species.

Licking was performed more frequently by the female to her offspring than the reverse, and licking was more frequent during the 1st week postpartum (12.45 times/h mother to kid, 0.73 kid to mother) than during the next 2 weeks (0.61 times/h mother to kid, 0.09 kid to mother). The duration of licking bouts was similar between the 1st week ($\bar{X} = 16.0$ s, $n = 27$, $SD = 21.2$) and the next 2 weeks ($\bar{X} = 16.9$ s, $n = 29$, $SD = 22.8$) ($z = 0.04$, $P > 0.05$).

During the 1st week postpartum, mothers approached the kid more frequently (6.96 times/h) than kids approached the mother (1.83 times/h). However, in the 2nd and 3rd weeks postpartum, approaches by females decreased to 0.39 times/h. Kids approached the mother 0.86 times/h, so kids initiated contact more than the mother in the 2nd and 3rd weeks postpartum.

We observed that female Spanish ibex tend to isolate themselves from the herd 1 or more days before giving birth, as described for Alpine ibex (*C. ibex*; Couturier, 1962) and feral goats (Rudge, 1970).

Walther (1965, 1968) classified offspring as "followers" if they stay in close physical proximity to their mothers following birth, and as "hiders" if they spend the 1st days or weeks after birth secluded at a distance from their mothers. Different postpartum behaviors have been reported for *Capra*. Walther (1961) considered that Alpine ibex in captivity do not hide, but Savinov (1962) observed that young free-living Asiatic ibex (*C. caucasica*) hide for 2 to 3 days. Feral goats were reported as hiders by Hafez and Scott (1962) and Lickliter (1984*a*). Rudge (1970) found that feral-goat dams remained in the vicinity of neonates as long as 4 days postpartum when the neonate was lying-out. O'Brien (1984) observed that postpartum behavior of feral goats varied with maternal age. Holst (1980) noted that feral goats modified their postpartum behavior in relation to forage availability. Our observations indicate that Spanish-ibex mothers remained in the proximity of the neonate during the 1st days postpartum when the neonate was lying-out. We observed a close relationship between mother and kid, with the mother primarily responsible for proximity during the 1st days postpartum. As Lickliter (1984*b*) indicated for feral goats, kids are responsible for achievement and maintenance of mother-infant proximity beyond the 1st week following parturition.

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