

TIMING OF FEEDING BOUTS OF MOUNTAIN LIONS

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Onset of feeding by mountain lions (*Puma concolor*) on individual prey was studied with an automatic camera near mule deer (*Odocoileus hemionus*) that had been killed and cached by mountain lions. We categorized mountain lions as adult males, adult females, females with juveniles, and females with kittens. After sunset, females with kittens returned to kills significantly earlier than males, females, or females with juveniles. Early feeding by females with kittens might reflect avoidance of conspecifics, which are known to kill kittens. Alternatively, mothers with young kittens may remain closer to caches of prey than lone males, females, or mothers with juveniles. Increased energetic needs of lactating mothers also may dictate earlier feeding.

Key words: *Puma concolor*, mountain lion, caching, feeding ecology, predation, remote photography, California

Mountain lions (*Puma concolor*) are large cryptic carnivores for which intraspecific aggression has been documented widely (Anderson et al., 1992; Sweanor, 1990). Adult females generally have overlapping home ranges that are included in the range of one or more adult males (Seidensticker et al., 1973). In areas of home-range overlap, females may reduce aggressive encounters with each other through a system of mutual avoidance based on scent marking (Seidensticker et al., 1973). However, adult males sometimes kill each other or females, and infanticide by adult males is not uncommon (Anderson, 1992; Sweanor, 1990).

Females that minimize opportunities for encounters between their offspring and other adults might increase survival of their kittens. This may be accomplished through spatial or temporal partitioning of habitats. Mountain lions exhibit largely crepuscular or nocturnal patterns of activity (Beier et al., 1995; Maehr et al., 1989) and prey primarily on large ungulates that generally

provide more than one feeding opportunity (Ackerman, 1986; Dixon, 1982; Hornocker, 1970). Females with kittens that visit cached prey at different time periods than other social categories of mountain lions could incur fitness benefits by further minimizing the probability of contact with conspecifics.

Because mutual avoidance has been suggested as an important aspect of social behavior of mountain lions, especially on a large scale with respect to use of home range (Seidensticker et al., 1973), we hypothesized that this form of habitat partitioning also may occur on a daily basis with respect to feeding times. We used the natural tendency of mountain lions to return to previously killed prey to test the null hypothesis that timing of feeding bouts does not differ among social categories.

MATERIALS AND METHODS

We conducted this research on ca. 250 km² in Round Valley, east of the Sierra Nevada in

northern Inyo and southern Mono counties, California (37°24'N, 118°34'W). The area was dominated by sagebrush (*Artemisia tridentata*), blackbrush (*Coleogyne ramosissima*), rabbitbrush (*Chrysothamnus nauseosum*), and bitterbrush (*Purshia tridentata*) and was bisected by several streams and associated riparian vegetation of primarily *Betula occidentalis*, *Rosa*, and *Salix* (Kucera, 1988).

Round Valley provided winter range for a population of mule deer (*Odocoileus hemionus*) that ranged in size from ca. 900 in 1991 to 1,600 in 1996 (Clark, 1996). A small population of ≤ 20 mountain sheep (*Ovis canadensis*) also occurred immediately west of Round Valley (Torres et al., 1996). In winter, these ungulates coexisted with a resident population of ≤ 9 adult mountain lions during this study (B. M. Pierce, in litt.).

We captured 35 different mountain lions in Round Valley from November 1991 to May 1995. Mountain lions were chased into rocks or trees by hounds and immobilized with a mixture of ketamine and xylazine in a 5:1 ratio or Telazol® (Elkins-Sinn, Inc., Cherry Hill, NJ) administered with a Palmer Capchur® Rifle or jabstick (Davis et al., 1996). We fitted 27 mountain lions with telemetry collars (Telonics, Inc., Mesa, AZ) and metal ear tags. Telemetry collars were individually recognizable because colored plastic tags were riveted to each side of the collar. We classified individuals weighing < 22 kg, traveling with their mothers, and exhibiting pelage characteristics of mountain lions ≤ 6 months of age (Shaw, 1979) as kittens and did not fit them with telemetry collars. Juveniles weighed ≥ 22 kg but still traveled with their mothers; they were fitted with telemetry collars when captured. All aspects of this study were approved by the Institutional Animal Care and Use Committee at the University of Alaska Fairbanks and were consistent with American Society of Mammalogists guidelines (*ad hoc* Committee for Acceptable Field Methods in Mammalogy, 1987).

From November 1991 through April 1996, we located collared mountain lions from the air and on the ground. During this period, we located 199 carcasses of mule deer and one carcass of a mountain sheep that had been killed by mountain lions. We established a photographic station at 40 fresh (≤ 48 -h-old) carcasses using a commercially available camera unit (Trailmaster®, Goodson and Associates, Inc., Lenexa, KS; Ku-

cera and Barrett, 1993). We left the camera station in place until the carcass was consumed or was abandoned by the mountain lion. We examined cameras daily and replaced film (35mm, ASA 400 color) as necessary. We programmed the Trailmaster® to take one frame every 30 or 60 s, as long as the infrared beam that triggered the camera continued to be broken. An event recorder tabulated the number and times that the infrared beam was broken, regardless of whether a photograph was taken; however, only data based on the first photograph taken each night that a mountain lion returned to a carcass were analyzed here. We grouped mountain lions visiting photographic stations into four social categories: lone males, lone females, females with kittens, and females with juveniles.

We determined the length of time after sunset (Pacific Standard Time; Farmighetti, 1994) of the onset of feeding for each adult animal in each type of category. Mountain lions returned to their kills 47 times. The number of different adult mountain lions and the number of nights sampled for each social category were: males 5,13; females 8,16; females with kittens 6,11; and females with juveniles 3,7. Four of 11 females were sampled in more than one category, dependent on presence or absence of young. To avoid pseudoreplication (Hurlbert, 1984), we treated the mean value for individuals sampled more than once within a social category as a single event; this reduced our total sample to 22 events. We compared feeding times among social categories with a Kruskal-Wallis (H) test (Zar, 1984), followed by a Tukey-type multiple comparison test (Q) for unequal sample sizes (Zar, 1984). Statistical significance was set at $P \leq 0.05$.

RESULTS

We obtained 412 photographs of adult mountain lions at carcasses of 37 deer (Fig. 1) and one mountain sheep. Median time of onset of feeding for all groups was 3.09 h after sunset (Fig. 2). There was a significant difference among category types in the onset of feeding relative to sunset ($H = 10.208$, $d.f. = 3$, $P = 0.017$). No differences in the onset of feeding time existed among males (3.164 h), females (4.849 h), and females with juveniles (4.312 h); however, females with kittens (1.216 h) arrived at car-



FIG. 1.—Visit by a mountain lion kitten to the carcass of a mule deer in Round Valley, Mono Co., California, January 1992; the adult female watches from behind.

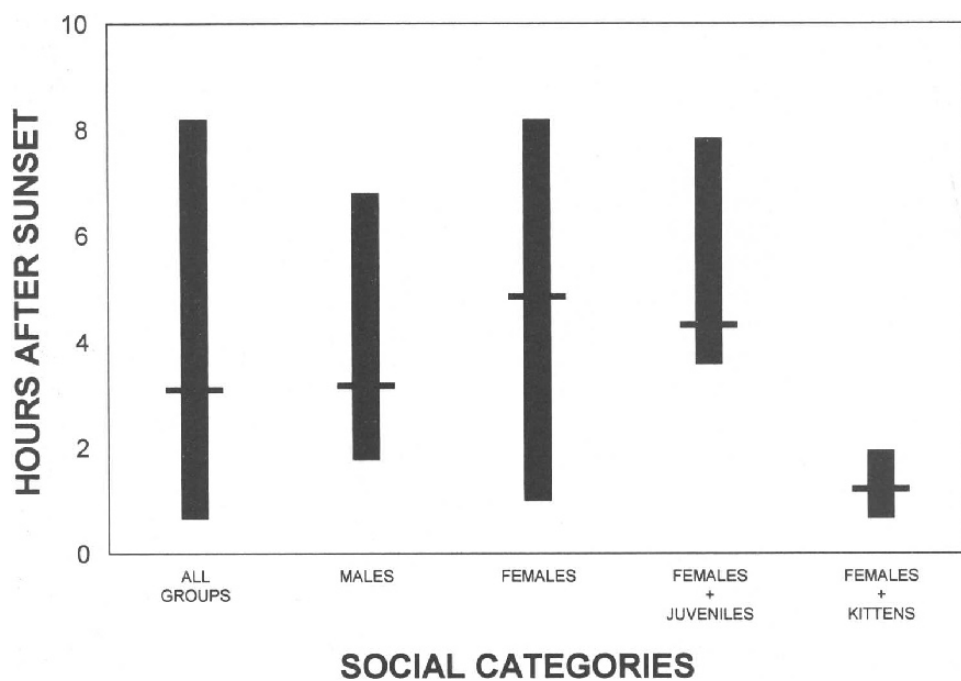


FIG. 2.—Number of hours (median and range) elapsed after sunset before mountain lions returned to feed on cached deer, Round Valley, California, 1991–1996.

casses significantly earlier ($Q = 2.66$, $P < 0.05$; Fig. 2) than other social categories of mountain lions. Females with kittens commenced feeding an average of 3.32 h before males, lone females, and females with juveniles.

DISCUSSION

Our results indicate that nocturnal feeding activity of female mountain lions with kittens begins earlier than that of other social categories of mountain lions. We suggest that this behavior decreases mortality of kittens by minimizing encounters with potentially aggressive conspecifics. Intraspecific aggression poses a serious threat to mountain lion kittens, and females with kittens that avoid conspecifics may enhance the survival of their offspring.

Beier et al. (1995) concluded that mother mountain lions selected den sites in part because of their relative inaccessibility to other predators, and mothers minimized the presence of scents that could make the site conspicuous. Thermal advantages provided by dens also could result in fewer comfort movements by kittens and reduce encounters with potential predators while kittens were still in the den (Bleich et al., 1996). Seidensticker et al. (1973) reported that two of 94 associations between social categories of mountain lions involved females with small kittens and noted total avoidance between females with small kittens, lone males and lone females. Anderson et al. (1992) summarized the literature on intraspecific predation in mountain lions and reported that 35% of 20 records involved adults killing kittens. We observed similar behavior during our study; one mortality of a kitten was attributed to intraspecific aggression and one kitten survived a pursuit by an adult male. In addition, we recorded two cases of adult males scavenging on deer killed by females with kittens, further suggesting that early feeding by females with kittens is adaptive.

Two other hypotheses also may explain behavior of females with kittens. First, fe-

males with kittens may stay closer to kills during the daytime because of the limited mobility of kittens. Consequently, the earlier return to kill sites could simply be a matter of travel time. Alternatively, females with kittens have greater energetic needs than those without kittens (Ackerman, et al., 1986). Beier et al. (1995) located four carcasses that were fed on during daylight hours, three of which were consumed by a mother with kittens; however, diurnal feeding was uncommon (<9%), suggesting that hunger did not fully explain the earlier return of females with kittens to kills.

Given risks associated with intraspecific aggression among mountain lions, partitioning of resources could be adaptive. Our results are consistent with the hypothesis that females with kittens decrease the probability of encountering conspecifics through temporal partitioning of feeding activity.

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