

IMPLICATIONS OF MATERNAL SEPARATION ON OVERWINTER SURVIVAL  
OF MOUNTAIN GOAT KIDS

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ABSTRACT

It is calculated that, annually throughout North America, approximately 3000 mountain goat (*Oreamnos americanus*) kids enter their first winter without a mother. Only 20 percent of these kids are a result of female harvest practices; the remainder are a consequence of the breakdown in the nanny-young bond. A review of mountain goat literature generally reveals positive opinions pertaining to overwinter survival of these kids. Important components influencing winter kid survival are addressed; these include time of weaning, predation, intraspecific behaviour, winter distribution and food habits. Theoretical implications provide little evidence for differential rates of kid survival even though maternally-separated kids may become subordinate and subject to increased aggression from conspecifics.

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INTRODUCTION

High levels of juvenile mortality occur in most big game ungulate species (Caughley 1966). Major components contributing to this mortality phenomenon are adverse climatic conditions (Moen 1973), disease (Spraker and Hibler 1982), abnormal maternal care and juvenile inexperience (Rheingold 1963).

The effect of premature mother-young separation (i.e. prior to behavioural weaning) has received increased attention by wildlife researchers. Systematic studies on survival of these offspring were previously expressed by Lent (1974) as an essential requirement of big game management.

To date, observations or studies of maternally-separated or orphaned young have been conducted on pronghorn antelope (*Antilocapra americana*) (Bromley and O'Gara 1967), mule deer (*Odocoileus hemionus*) Swenson 1972),

white-tailed deer (*O. virginianus*) (Reed 1974), bighorn sheep (*Ovis canadensis*) (Wishart 1976, Smith and Wishart 1978), domestic sheep species (Zito et al. 1978, Arnold and Dudzinski 1978), moose (*Alces alces*) Altmann 1958, Johnson et al. 1973, Markgren 1975, Sigman 1977) and grizzly bears (*Ursus arctos*) (Jonkel et al. 1980). Interspecific differences in overwinter survival are apparent. For example, moose calves orphaned in the fall are highly vulnerable to winter mortality, whereas juvenile white-tailed deer, pronghorn and bighorn sheep are generally considered to survive.

The purpose of this paper is to review and compare relationships affecting overwinter survival of mountain goat kids separated from their nanny to those with a natural mother. The importance of maternal care is examined within the concepts of natural metabolic and behavioural weaning processes (Sadlier 1980), protection from predators and aggressive conspecifics, and identification of winter habitat and forage types.

#### LITERATURE REVIEW OF MOTHERLESS KID SURVIVAL

No systematic studies have been conducted on overwinter survival of maternally-separated mountain goat kids. Contradiction in findings and opinion are revealed in the scant information published or presented in theses. Brandborg (1955) stated that if motherless kids are left to their own devices, their survival is doubtful. He based his conclusion partly on one case of an emaciated 7 month old kid found dying from what appeared to be starvation. Other researchers (Chadwick 1973, Rideout 1974, Hebert and Turnbull 1977, Kuck pers. comm.) also speculated that chances of a motherless kid surviving are further reduced than if they were with a female. These beliefs were based on the premise that maternal leadership, alertness, aid and protection is essential to the survival of young through the first winter.

Consequently, conservative attitudes stress the importance of the nanny in rearing her young. Wright (1977) recommended that hunting nannies who are accompanied by kids or yearlings should be prohibited until subadult age classes comprise 35 percent of the herd. Several game management agencies have recently implemented strict harvest regulations or pleas to the hunter. For example, in a review of 1981 game regulations, Nevada emphatically discouraged and Washington recommended against the harvest of females accompanied by kids. The Yukon Territory made the harvest of maternal nannies illegal.

Conversely, a number of researchers have provided evidence for motherless kid survival. For example, Kerr (1965) reported 93 percent overwinter kid survival in Alberta after a fall hunting season in which 40 percent of the herd (n=35 goats) was removed. Some kids were undoubtedly orphaned, prior to the severe winter experienced in the area. Similarly, Foster (in prep) observed kid survival rates of 73 and 63 percent over two consecutive mild winters in British Columbia. Eight hunter-induced orphans

and at least four kids naturally separated from their mothers, were known prior to the second winter, however the difference in survival rates between the two years (9.8%) accounted for a discrepancy of three or four kids only, suggesting that no significant differential rates of orphan and non-orphan and non-orphan kid mortality occurred.

In Montana, Chadwick (1973) noted that two orphaned kids survived a very mild winter in his study area and Rideout (1974) recaptured two of his marked kids which were separated from their nannies during marking procedures the previous year. One was emaciated and had trouble walking (a male), and the other (a female) was in good physical condition. Additionally, Thompson (1981) noted the apparent survival of a hunter-orphaned kid over a severe winter. He also cites a pair of orphaned twins (generally considered less fit than individual newborn) surviving their first two consecutive winters, both of which were considered severe.

## DISCUSSION

### OCCURRENCE AND FREQUENCY OF MOTHER YOUNG SEPARATION DURING BEHAVIOURAL WEANING

Four processes are involved in the loss of maternal care to mountain goat kids during their behavioural weaning period: (1) temporary, accidental separations (due to weaning conflict and juvenile independence) occur predominantly in June and July, (2) permanent (sometimes accidental) separations (due to higher levels of juvenile independence and further weakening of the maternal bond) generally occur in August and September, (3) hunter-induced orphaning (harvest of the nanny) usually takes place in October, and (4) natural orphaning (death of nanny from natural causes or predation) is most susceptible during critical periods, from November through March.

By measuring distance of the kid from its nanny, DeBock (1970) showed that kid independence steadily increased with time from birth. This results in accidental and temporary maternal-young separations being observed with increasing frequency as the period of weaning conflict (Berger 1979) progresses (Brandborg 1955, Chadwick 1973, Foster and Rahe unpubl. data). No information is available on the rate on maternal abandonment for mountain goats, however inexperienced mothers are a common source of this phenomenon (Rheingold 1963).

After the period of metabolic (or nutritional) weaning (about 4-5 weeks), separations continue to occur with increasing frequency, but on a more permanent basis, as kids are no longer dependent upon the nanny for milk. Foster and Rahe (unpubl. data) recorded nearly 10 percent of an annual kid cohort to have maternal ties permanently severed by early October (and prior to hunting). This corresponds to approximately 1300 kids being naturally separated from their mothers by mid-October each year in British Columbia.

Hunter-induced orphaning is believed to be much less significant, based upon hunting restrictions discussed earlier and subsequent harvest statistics, and hunter morals. In British Columbia, where approximately 45 percent of North America's mountain goats reside and are harvested (Johnson 1977), it is estimated that approximately 2 percent of all goat kids (n=250) are orphaned by hunting. This figure is obviously dependent upon the proportion of hunters who would shoot a nanny accompanied by a kid, and therefore may be actually less<sup>1</sup>.

The incidence of natural orphaning, or death of the nanny, is believed to be slight as numerous researchers have failed to document significant levels of adult goat mortality (Chadwick 1973, Vaughan 1975, McFetridge 1977). Nanny mortality would be expected to occur more so during late winter-early spring, when old females should be in a poorer nutritional state. Accidents, avalanches and old age are believed responsible for most adult deaths. Vaughan (1975) theorized that adult goat predation is low due to the ability of mature goats to defend themselves and the absence of a specialized predator.

In all of North America it is estimated that natural, permanent nanny-kid separations, in addition to hunter-induced orphans, account for approximately 3000 kids entering the winter without a mother each year. The kid figures were based upon: (1) population estimates from Johnson (1977) and the British Columbia Ministry of Environment (1979), (2) total annual British Columbia harvest figures gathered over a 12 year period (1965-1976) (Macgregor 1977), (3) total annual British Columbia harvest of males and females over an 11 year period (1965-1975) (Foster 1977), and (4) male:female and kid:female ratios from Anderson (1940), Cowan (1944), Hanson (1950), Brandborg (1955), Kerr (1965), Chadwick (1973), Rideout (1974), Hebert and Turnbull (1977), Foster and Rahe (1981) and Foster (in prep). A ratio of 65 males:100 females was used in the calculation.

#### FACTORS INFLUENCING MATERNALLY-SEPARATED KID SURVIVAL DURING BEHAVIOURAL WEANING

##### Weaning Conflict

Mountain goat kids fall into the category described by Lent (1974) as followers, and parental investment early in life is high (DeBock 1970, Chadwick 1973, Rideout 1974). However a rapid progression is observed in the breakdown of the mother-young bond prior to metabolic weaning. In fact, maternally terminated suckles start within 2-4 days subsequent to birth (DeBock 1970). The major immediate result is a decrease in milk supply to the offspring (Trivers 1972, 1974).

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<sup>1</sup>This estimate is based upon the fact that, on average, 55 out of every 100 adult females is accompanied by a kid and that females with and without kids are harvested equally.

Within one week, newborn are mouthing plants. By the age of 4 to 5 weeks, DeBock (1970) stated that kids are feeding extensively on solid foods. Casebeer et al. (1950) also noted that kids are weaned by their fourth week. After this period, milk appears to have only a behavioural significance, being merely a dietary supplement, with frequency and duration of nursing averaging approximately one suckle per eight hour period. Chadwick (1973) noted that nursing durations were sharply curtailed and that frequent rejections occurred at this age. By August, McFetridge (1977) found that it was often difficult to associate any kid with a particular nanny. At this time, DeBock (1970) stated that almost all nursing attempts are resisted by the nanny and that kids appear to be fully weaned (metabolically) by their fourth month. Sadlier (1980) found that black-tailed deer fawns (Odocoileus hemionus columbianus) were also weaned in a metabolic sense before they were behaviourally weaned.

Kids were observed by McFetridge (1977) to be largely independent by late September (when hunting season started in Alberta). Most of the naturally-separated mountain goat kids observed by Foster and Rahe (unpubl. data) were documented immediately after metabolic weaning (i.e. late August to early October). A marked increase in mother-young distance was noted by DeBock (1970) during the rutting season, suggesting a progressively normal breakdown of the mother-young bond prior to winter. Chadwick (1973) additionally noted that a lack of interest by nannies towards their own offspring increased through the winter. By late winter, he observed short yearling groups with increasing frequency.

#### Predation

The ability of adult goats to dispatch predators, as described by Guiget (1951), Cowan (1944), Kerr (1965) and Smith (1976), suggests that predation is most successful on subadult cohorts. Brandborg (1955) stated that wandering kids are extremely susceptible to predation and kids were found by Chadwick (1973) to be the least alert class of goats. However, our own observations, in conjunction with those of Holroyd (1967) and Wright (1977) infer that kids and yearlings are the most alert and the first to display alarm.

Goat researchers have witnessed successful predatory acts involving eagles, wolves and mountain lions only. Brandborg (1955) and Smith (1976) report in total, three cases of observed eagle predation, all of which were restricted to young kids. However, Anderson (1940) refers to the non-selective eagle predator strategy of striking an adult goat (a billy) and successfully knocking another (a yearling) off a ledge. Cowan (1947), Carbyn (1974) and Fox and Streveler (1979) each documented successful wolf attacks, but only on young goats. It could not be determined from the available literature whether or not mountain lions had selected for kids, as no successful predatory acts were documented in detail (Cowan 1944, Young and Goldman 1946, Holroyd 1967, Burleigh 1978).

Casebeer et al. (1950) and Chadwick (1977) described predator confusion during attacks on large goat groups. The authors have noted similar responses by goats, however we also documented that responses to other disturbances (primarily aircraft) were independent of group size (Foster and Rahe 1981). Therefore, if motherless kids are social, as suggested by Rideout (1974) there should be similar chances of survival for both kids with their true mother and kids without. In any event, predation appears to be so low that no significant population changes result (Klein 1953, Smith 1976).

#### Intraspecific Stress and Aggression

Stress may be placed upon kids through agonistic behaviour of conspecifics, however this is usually reduced by maternal aggression when other goats approach too close to young offspring (DeBock 1970, Chadwick 1973, Wright 1977). Consequently, kids with mothers become associated to some extent with the dominant status of nannies (Chadwick 1973). Disturbances usually induce nursing behaviour by kids (DeBock 1970, Chadwick 1973). Brandborg (1955) speculated that the high frequency of nursing he observed may have been due to his nearby presence and associated disturbance, implying traumatic relief from the nannies' presence. Liddell (1958, 1961 - in Geist 1971) found that physic trauma was fatal to domestic goats and sheep separated from their mothers, but not if it occurred in her presence. However, Dailey (1981) has shown that newborn mountain goat kids, taken away from their nanny, developed rapidly in captivity, and in good health, given a nutritionally balanced diet.

Mountain goat kids separated from their mothers become the least dominant members of all groups. Thus they receive increased levels of agonistic behaviour from most other cohorts (Chadwick 1977). These kids also create stress among conspecifics (primarily nannies with young) because of their selection towards foster mothers or foster groups (Rideout 1974). Craig (1981) described added stress within a group when a strange member joins, resulting in increased aggression and decreased forage consumption. Lost or orphaned kids generally do not leave their foster groups voluntarily, but may be driven off by intolerant group members. A means of reducing this aggression is demonstrated by the occasional pairing-up of motherless off-spring who winter for the most part by themselves (Thompson 1981, Foster and Rahe (unpubl. data).

#### Winter Distribution

Winter habitat use by goats is ultimately dictated by snow characteristics (Adams 1981, Dailey 1981), with secondary influences generally imposed by forage and other thermal conditions (Peck 1972, Rideout 1974, Bailey and Johnson 1977). Thick snow cover encourages goats to aggregate, thus reducing both the number of single animals and increasing the occurrence of mixed groups (Casebeer et al. 1950, Lentfer 1955, Petocz 1973, Rideout 1974).

It is conceived that during winter social aggregational tendencies direct motherless animals to traditional wintering areas where their own mothers might otherwise have led them. Of course this may not be possible if population densities are extremely sparse and long seasonal migrations are involved, or if excessively large snowfalls trap animals in unfavourable winter habitats. However, these situations are normally believed to be an exception rather than the rule.

During winters of heavy snow-fall, social integration may become advantageous to motherless kids in the sense that conspecifics develop well-trodden trails between scattered areas of available food and cover, thus reducing potentially high levels of physical exertion required for locomotion. Competition and range overuse may occur if winter range is limited, but not to the exclusion of motherless kids.

#### Food Habits

Chadwick (1973) stated that in winter, kids depend to a considerable degree upon their mothers to paw snow from forage. However, our observations over two winters showed high levels of independence among kids. Only rarely did we observe kids to utilize their mother's feeding crater (Foster and Rahe unpubl. data). Kids were mainly observed to dig their own snow craters and feed adjacent to their mother. Nannies were observed to occasionally become aggressive towards intruders, including their own offspring. Both studies were conducted during winters of light snow-fall. Petocz (1973) showed that during the deep snow period of winter, high levels of agonistic behaviour resulted in competition for feeding craters. When snow depths increased, we also observed more crater parasitism, however a change to browsing habits generally occurs at such times (Dailey 1981).

By selecting similar habitat types of other goats (by following them), forage conditions should not significantly alter for motherless kids. Under rigidly controlled studies, Dailey (1981) found that not only did tame, motherless kids and yearlings selectively eat certain plant species, and also the most nutritious components (i.e. leaves and flowers), but the animals were capable of altering diet choices in an apparent response to differences in nutrient composition among forages. He concluded that the motherless goats choose diets largely similar in composition to diets of wild goats.

#### SUMMARY AND CONCLUSIONS

Incidents of natural separation of mother and young start during postpartum isolation and commonly occur with increasing frequency during the progressive breakdown of the nanny-kid (weaning). Many researchers do not distinguish between complete metabolic weaning (generally less than 120 days) and behavioural weaning (up to one year in goats).

Rideout (1974) concluded that separations do not invariably result in the motherless kid's death as suggested by Brandborg (1955). We support Rideout's conclusions that under these circumstances a kid typically follows a foster group or joins another motherless kid. Our general discussion of potentially influencing factors affecting overwinter survival of these kids suggests little reason for differential rates of mortality between the two kid categories. Although an absence of systematic studies is evident, the general consensus of the literature agrees with our observations. We conclude that: (1) milk requirements subsequent to late summer (September) are not essential for over-winter juvenile survival; (2) predators appear to select for young offspring, however no differential selection should occur between social orphans and non-orphans; (3) winter, in particular, induces goat aggregational tendencies and therefore a learning response for use of winter habitat; (4) kids generally paw snow to expose forage independently; (5) maternally-deprived kids have the ability to select both highly nutritious plant species, and their components, and exhibit seasonal alterations in their diets corresponding to plant nutritional values; and (6) kids taken from their mother at an early age develop rapidly and remain healthy in captivity. We must stress that maternally-deprived kids may fall into a lower position in the dominance hierarchy and consequently receive premature levels of increased aggression (predominantly from nannies) at an earlier age. An additive effect is that of increased agonistic behaviour and resultant energy cost to gestating adult females.

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## CONFERENCE DISCUSSION

Q. In the northern half of British Columbia, our hunting seasons opened on August 1st for goats. Now some of them have shifted ahead to August 15th. Do you think that has any effect on the survivability of kids?

Ans. We found from our field work in the Terrace area that most resident hunting activity generally did not commence until mid-October, when stormy weather and new snow forced the animals down to lower elevations. Our resident hunters tend to be a little bit lazy. Many road-hunt goats, as people road-hunt deer and moose. Therefore goat hunters usually wait for the last possible chance. Generally the season ends October 31st in most areas. Non-resident hunters, on the other hand (contributing to about half of the provincial goat harvest), often hunt in August and September, but they are generally after male trophies.

Q. But females comprise a rather large component of the harvest in B.C. Don't you feel that the incidence of hunter-induced orphaning may be rather high and with significant effect?

Ans. No I do not. Firstly, because I've found that the resident hunter harvest averages about 40% females and non-residents about 30%. Only half of most female goats are accompanied by a (single) kid, and these animals are usually selected against by the hunter. Secondly, the incidence of hunter-induced orphans appears to be far outweighed by the number of orphans created via natural separation from their mother, say, by the end of September.

Q. I wonder about your comparison with Tom Dailey's goats to the ones that are orphaned in the wild. His goats got an awful lot of attention. I wonder about the human caretakers that are filling in the mother-role a little bit. Couldn't these goats also have been influenced in their free-ranging food habits by captive-rearing?

Ans. Although the social implications of a surrogate mother may eventually eliminate the social stress of a kid removed from its original mother, there also existed the likely event that abnormally high levels of trauma may have been induced to these motherless kids subsequent to capture in the wild. The effects of this have not been measured. To answer your second question, I would like to say that the highlight of Dailey's thesis was that the goats in captivity were initially fed a diet of milk (until September), and later, alfalfa hay. They weren't supplemented by natural foodstuffs from traditional goat ranges (or the study area). Also there was no learning between animals because all feeding trials were conducted with individuals. So it was apparent that innate behaviour was involved in their ability to select more nutritional forages.