OBSERVATIONS OF PRE- AND POST-PARTUM BEHAVIOUR OF MOOSE IN CENTRAL ONTARIO

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ABSTRACT: During May, 1981-1984, observations of female moose (*Alces alces americana*) with neonates were recorded on 55 occasions. Presence of parturient but no non-parturient adult moose on islands is consistent with moose selecting islands for calving. Alternative explanations for this distribution are discussed. Newborn calves were first observed between May 11 and 16. Thirteen females arrived on islands a maximum of 1.5-7 days prior to being found there with calves. Yearlings accompanied some females to calving islands. Many islands and some of the same bedding sites were used in more than one year but not always by the same moose. Scratch holes at calving sites were created by moose and may constitute territorial marking. Birthing membranes observed may have been expelled a number of days after parturition. Meconium and other calf feces were seldom present.

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Pre- and post-partum behaviours of free-ranging moose have been described by Altmann (1958,1963), Markgren (1969) and Cederlund (1987) and of confined or semi-domesticated moose by Knorre (1959 in Stringham 1974), Stringham (1974), Cederlund (1987) and others. However, descriptions of pre- and post-partum behaviour of wild *Alces a. americana* remain limited. Being in the field to capture moose calves for other studies led to observations of peri-partum moose sign and activities.

The objective of the present study is to describe some pre- and post-partum behaviours of free-ranging *A. a. americana* including seasonal timing of calving; potential selection of islands as calving sites; peri-partum arrival of moose at calving islands; repeated use of calving sites; and presence of scratch holes, birthing membranes, calf feces, and dead moose at calving sites.

STUDY AREA AND METHODS

The study area is approximately 5000 km^2, centred around Big Trout Lake (45°46'N, 78°7'W) in Algonquin Provincial Park, in central Ontario. The area has irregular topography over granitic bedrock, with mixed forests and many lakes. It is within the Algonquin-Pontiac Section of the Great Lakes - St. Lawrence Forest Region (Rowe 1972). Hunting of moose has been prohibited within the study area since 1886 (Addison 1974). Densities of moose increased from 0.1-0.2 per km^2 in 1974-1975 (Wilton and Pashuk 1982) to 0.5 per km^2 in 1984 (M. Wilton, pers. comm.)

One hundred and forty-five islands were visited at least once from 1981 to 1984. Islands searched were readily accessible by boat or aircraft. Most were small enough that female moose with calves could be confronted or driven to water for capture of calves. Daily ground searches commenced May 6-10 annually (Table 1) and were conducted as described by Addison *et al.* (1985). A limited number of peninsulas were also searched for females with neonates. Islands previously identified as being used for calving were repeatedly searched on at least a weekly basis from early May until at least one female with calves was present or until late May. These repeat visits allowed for estimates of when females arrived on islands and when calving occurred. Ten females were radio-tagged during this study; an additional 13 were radio-tagged in the study area by other researchers

Table 1. Dates of surveys and location of female-calf moose groups, Algonquin Provincial Park, 1981-84.

	Dates of search		Dates when calves observed		No. of female-calf groups	
Year	First	Last	First	Last	Island	Mainland
1981	May 6	May 26	May 13	May 26	11	0
1982	May 10	May 25	May 16	May 25	8	1
1983	May 9	May 27	May 11	May 27	11	0
1984	May 9	May 31	May 15	May 31	17	7

(see Wilton and Bisset 1988). Pre-partum movements of some radio-tagged moose were monitored remotely.

RESULTS

Timing of Calving

Nine to 24 females with calves were observed annually (Table 1). Calves were first observed May 11 to 16 with additional calves found until searches were termined in late May (Table 1). In general, female-calf groups were encountered almost daily from May 17-25. Median dates for finding females with neonates were May 18-20.

Islands used for calving were first located in 1981. In subsequent years, many of these same islands had no moose when visited early in May, only to contain dams with calves on subsequent visits. Thirteen females were not on the islands used for calving 1.5-7 days before being observed there with calves. One radio-collared female either travelled 1.2 km across a lake, 6-9 km around part of the lake, or took some longer route to reach an island where she had calves when approached 36 hrs later.

Moose on Islands

Twenty of the 145 islands searched were used by moose for calving at least once during the study. The number of parturient moose/island was 1,2,3,and 4 for 14,3,1,and 2 islands respectively.

Forty-seven females with calves were located on islands and eight on the mainland which included peninsulas (Table 1). No mature bulls were observed on islands although three were seen on peninsulas. Three adult females with yearlings were observed on islands; two of these females did not subsequently have calves by the end of May. Three solitary yearlings were on large islands where female-calf groups were also observed.

Repeated Annual Use of the Same Calving Areas

On three islands, the same calving area was used in different years, sometimes by different moose. On one island, two radio-collared and one uncollared moose used the same calving area (one/year) during three of four years of the study. Two of the females used precisely the same spot within the calving site for their main bed. On the second island, 2 different radio-collared females used exactly the same main bed in the first and fourth years of the study. In the second year, a different uncollared female used a main bed no further than 30m away. The third island had 1-3 calving sites annually. Exactly the same bed was used as a main bed during the first and third years of the study. We did not observe a radio-collared moose re-use exactly the same calving site.

Scratch Holes at Calving Sites

Scratch holes are depressions made by moose removing leaf litter and digging into

the soil beneath. Moose tracks were sometimes located within and around the holes. A sweet smell was detected in 8 of 21 scratch holes checked for odour.

Twenty-four scratch holes were observed at 12 different calving sites with up to 4/site. Scratch holes were located at calving sites on both peninsulas (n=3) and islands (n=9). The distance of scratch holes from the main bed was 20-200 m (n=9). Scratch holes were 51-140 cm long and 29-65 cm wide with 17 of 24 being 60-90 x 30-35 cm. Leaves were displaced up to 2.7 m from the back of the holes.

Five of six calving sites with more than one scratch hole were on islands with more than one simultaneously active calving site. In addition, 17 of 21 scratch holes on islands were observed when more than one moose was calving on the island. On 2 of 3 islands with a scratch hole and with a single female with calves, the holes were located on the shore of the island at the point of minimum swimming distance between the island and mainland.

Feces, Birthing Membranes and Dead Moose at Calving Sites

Calf feces, including meconium, were seldom observed at calving sites. We observed a female licking one of her standing calves shortly after parturition. As she licked the anal region, the calf defecated and the female ate the feces.

Birthing membranes (approximately 1-2 kg) were still present at 2 calving sites that were used by females with highly mobile calves. One female with mobile calves expelled membranes when immobilized. Another had some membranes dried to skin near the vulva. A female with mobile calves drowned after immobilization. Extensive birthing membranes had been retained within her uterus.

Dead moose were found at calving sites on 2 occasions. A female died with the head of one calf and feet of another protruding from the vulva. A calf was found dead and pressed into the ground litter and soil in a bed at a second calving site.

DISCUSSION

The estimated median dates of parturition were May 18-20. However, estimated time of parturition is influenced by methods used. For example, parturition may have occurred earlier for some females than was observed in this study. However, our inability to locate females with neonates during the first days of searching (Table 1) and the absence of females with neonates on some islands where females with neonates were present on subsequent searches provides a clear indication as to when those moose were parturient. The surveys were terminated in late May because leafout on ground and shrub vegetation reduced the likelihood of seeing retreating females with neonates. As a result, we would have seen few calves arising from a second or subsequent oestrus (see Coady 1974, Franzmann *et al.* 1987, Schwartz et al. 1988).

Despite variations and limitations in methods among studies, there is considerable similarity in the commencement of calving by moose in North America. Time of parturition as measured by first observation of neonates was similar, or perhaps up to one week earlier in this study (May 11-16), than that reported for moose in Alaska (May 15-June 1)(Rausch and Bratlie 1965; Gasaway *et al.* 1983), Alberta (May 17-21)(Hauge and Keith 1981), the Yukon (May 17-June 20)(Larsen *et al.* 1989), and Newfoundland (May 15-27)(Albright and Keith 1987).

The similarity in timing of parturition may be in response to similar climate-related pressures on survival of moose calves in different areas. Early born calves and their dams might experience severe late winter - early spring weather and a more prolonged period prior to new leaves being available as food. Calves born late would have reduced growing seasons and perhaps would be smaller enter-

ing their first winter.

Pre-parturition activities by females include separation from yearlings and arrival at calving sites. The long distance movement of one female to a calving area within 36 hours of being observed there with neonates is consistent with a previous report of definitive pre-partum movements of female moose prior to calving (Courtois and Crete 1988).

Presence of females with calves on islands have led others (Seton 1909, Clarke 1936, Peterson 1955) to suggest that female moose select islands for calving. However, previous studies have not addressed the possibility that parturient females or females with neonates on islands may only reflect a random distribution of the parturient segment of the population.

Do parturient females select islands over mainland sites for calving? The present study cannot unequivocally answer this question because some observations support the hypothesis while others are contradictory. Nonetheless, the data contribute to a better understanding of behaviors exhibited during time in the life history of moose.

We estimate 700-800 parturient females/ year in Algonquin's 5000 km^2 with a population density of 0.5 moose/ km^2. The 20 islands used for calving during at least one year of the study could have supported a maximum of 30 parturient females each year. Even if this constituted only 20% of females calving on islands, there would only be 150 females using island calving sites in any one year. Thus, most female moose in Algonquin Park probably use mainland sites for calving.

The use of only 20 of 145 islands does not support the view that parturient females prefer islands for calving. However, we urge caution in interpreting the significance of the relatively low proportion of islands used. Some of the 125 islands were unsuitable for calving because of insufficient vegetation for cover or because of possible conflicts with campers. Other criteria for a moose accepting or rejecting islands for calving may include distance from mainland for swimming, availability of food, presence of predators, characteristics of escape routes and more (see Addison et al. 1990). In summary, possible supply and demand ratios for 'suitable' calving islands remain speculative.

The greater number of females with calves observed on islands as compared to mainland areas in the present study should not imply selection of islands. This difference can be explained by our more limited searching of mainland areas as compared to islands and by our greater difficulty to observing female-calf groups that can continue to move ahead of approaching threats while unnoticed on land. However, the relative numbers of females with calves as compared to numbers of bulls, yearlings and females without calves on islands were not influenced by our methods and are consistent with parturient females selecting islands for calving.

Although the greater numbers of females with calves as compared to other cohorts implies preference by parturient females, this is not necessarily the case. Randomly distributed females with calves may be particularly intolerant of other moose at calving time and could have driven randomly distributed non-parturient adults (females and males) from islands. A similar intolerance of yearlings has been reported (Altmann 1958, 1963). However, even if this occurred, we would have expected non-parturtient moose on some of the 125 islands on which parturient moose were not observed. It is clear from the near total absence of non-parturtient moose from islands in May that there is little if anything to attract moose to islands if they are not parturient. For this reason, we feel that the preponderance of females with calves relative to non-parturient moose on islands may be some of the stronger evidence available in support of the view that female moose are selecting islands for calving.

The importance of islands as calving sites

must be kept in perspective. Not only are many of the females in the population calving on the mainland but Altmann (1963), Markgren (1969), and Stringham (1974) all noted characteristics of mainland calving sites that provided some of the same potential benefits (e.g. seclusion) as islands are thought to provide.

Moose sometimes return to calve at the site where they first calved (Baskin 1987). In the present study, removal of calves from all 16 females we encountered in 1981-1982 may well have influenced selection of calving sites by these and other females in subsequent years. This might explain why none of four females radio-tagged in 1981 and 1982 were noted at the exact same calving sites in later years. Nevertheless, repeated use of the same calving sites and/or actual beds by moose suggests a particular attractiveness of at least some specific calving sites. Different moose may be familiar with and use the same calving site in different years by having used the sites previously (see Baskin 1987) or by being born at the site themselves. This raises the possibility of familial relationships between parturient females that are concurrently using different sites for calving on the same islands. Ozoga et al. (1982) documented the proximity of birthing sites between mothers and daughters in white-tailed deer (*Odocoileus virginianus*). D. Garner (pers. comm.) is conducting more detailed research within the study area. His studies address familial relationships using tagged or radio-collared adult females and calves as well as genetic affinities determined from blood samples. Moose that use islands for calving may represent a limited number of families that use those locations as much because of prior experience as for particular physical characteristics of the site that have attracted them.

The only prior reference we have found to scratch holes produced by moose is the photographs of Wilton and Garner (1991) for the same study area. The presence of moose tracks within some holes is consistent with the holes having been produced by a moose pawing at the ground with its hooves. Further study could evaluate whether or not moose urine was the source of the distinctive smell in some of the holes.

We hypothesize that the purpose of scratch holes is to enhance seclusion by advertising the presence of the occupying moose and hence discouraging conspecifics from entering calving sites. Greater numbers of scratch holes on islands having more than one female-calf group is consistent with this hypothesis as is the location of scratch holes close to where other moose are likely to come ashore (see Addison *et al.* 1990).

Feces of calves were seldom seen even though many of our visits to calving sites occurred a number of days post-partum (as judged by mobility of calves). Perhaps consumption of calf feces occurs frequently and the absence of prior reports only reflects the limited number of female-calf post-partum interactions observed in the wild.

Female moose have been observed consuming birthing membranes within 3 hrs of parturition (see Cederlund 1987). Although Markgren (1969) indicated that birthing membranes were usually eaten by the female, he did report cases where they were not. Stringham (1974) reports that "Skuncke and Knorre have both indicated that cows seldom consume the afterbirth". In the present study, the presence of birthing membranes on islands where the calves are highly mobile, hence likely at least 4 days of age (see Markgren 1966, Cederlund 1987) suggests that there may be some variation in the rate of expulsion and consumption of birthing membranes in moose. Birthing membranes should not automatically be considered as indicative of the birthing site since membranes can be expelled days after calving.

Death of a female at parturition due to abnormal positioning of the fetus has been reported previously (Markgren 1969). The

single dead calf found within a bed may have been killed by the cow laying on it. Newborn calves are uncoordinated and unpredictable. They stand and move beneath and behind the dam while attempting to locate the udder. It is easy to imagine a calf being in the way when the dam lays down.

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