PRELIMINARY FINDINGS REGARDING ELEVATION AS A MAJOR FACTOR IN MOOSE CALVING SITE SELECTION IN SOUTH CENTRAL ONTARIO, CANADA

Mike L. Wilton[1] and Dale L. Garner[2]

[1]Ontario Ministry of Natural Resources, Whitney, Ontario, Canada KOJ 2MO; [2]State University of New York, College of Environmental Science and Forestry, Syracuse, New York, USA 13210

ABSTRACT: Thirty-five of 68 (51.5%) known island and mainland moose (*Alces alces*) calving sites in the Algonquin Region of south central Ontario, Canada, were situated at the highest point of the local and immediately surrounding terrain. Forty-nine of 68 (72.1%) calving sites were on the upper quarter (25%) of the immediately surrounding terrain; and 59 of 68 (86.8%) calving sites were on the upper half (50%) of the immediately surrounding terrain. No calving sites were found in depressions.

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Moose (*Alces alces*) in the Algonquin Region of south central Ontario are known to calve during May and June (Ontario Ministry of Natural Resources (OMNR) file reports). Annual spring surveys to establish fecundity in the Algonquin Provincial Park (APP) moose herd together with radio-collaring of cows and calves, plus chance sightings by OMNR staff and members of the public, frequently pinpoint the exact locations of island and mainland moose calving sites.

Addison *et al.* (1990) examined moose calving sites previously in APP and concluded that "no features were found to be characteristic of most calving sites." An examination of their methods however, revealed that vertical height (elevation) was not measured and we feel it is of primary importance in calving site selection by cow moose. The objective of this paper is to document and examine the possible importance of elevation as a major factor in calving site selection.

STUDY AREA AND METHODS

Algonquin Provincial Park is situated in the Algonquin Region of south central Ontario (45° 39'N, 78° 39'W) in which many lakes with islands and peninsulas are present.

Annual spring cow-calf surveys in Algonquin Park began in 1981 (Addison *et al.* 1985). People search islands and peninsulas while walking abreast, maintaining contact with one another visually, by voice, or through the use of portable radios, in late May and early June to find cows with newborn calves and establish the spring twinning rate. Calving sites are recognizable by the presence of a cow and calf or calves, together with severe disturbance of ground litter. Sites often contain evidence of birthing such as blood, portions of placenta or membranes, and occasionally a calf carcass (Leptich and Gilbert 1986).

Searchers view photographs of calving sites (Fig. 1) to establish a search image, and are shown actual sites encountered during searches of islands and peninsulas. Since many researchers are resource technicians it is becoming increasingly common to learn of mainland calving sites discovered during routine duties.

Additional sites have been found while collaring cows with newborn calves for research purposes and one site was confirmed by a logger who watched a cow calving in his operating area.

In all instances of confirmed calving sites elevation of the site above the nearest permanent water body was measured utilizing an electronic altimeter (Ultimeter Model 12, Peet Bros. Co. Inc., Ocean, N.J. U.S.A.). In addition, elevation from the calving site to the highest point of the immediately surrounding

Fig. 1. Calving site showing disturbance of ground litter, Algonquin Provincial Park, Ontario.

terrain was measured. Elevation of the calving site up the slope was expressed as a percentage of the total height of the slope. Mean difference between calving site elevation and high point elevation was evaluated using regression analysis and a paired *t*- test.

RESULTS

During the springs of 1989, 1990 and 1991, 68 active calving sites were located; 60 on islands (one of which was on an island peninsula), 5 on mainland peninsulas, and 3 on mainland sites not associated with peninsulas.

Nine of 68 sites (13.2%) occurred on the lower half (50%) of the slope, and 59 of 68 sites (86.8%) occurred on the upper half (50%) of the slope. Forty-nine of 68 sites (72.1%) occurred on the upper quarter (25%) of the slope and 35 of 68 sites (51.5%) occurred at the top of the slope.

Three of 68 sites (4.4%) occurred at <1 m elevation, but in one of these instances there was no appreciable elevation in the immediately surrounding terrain. No calving sites were found in depressions.

Linear regression revealed a significant ($F = 237.96$; 1,66 df; $P < 0.0001$) relationship between calving site elevation and high point elevation. The slope was significantly different ($\beta_0 = 0.88$; $t = 15.43$; $P < 0.0001$) from 1 but, the Y intercept was not significantly different from 0 ($\beta_1 = -1.23$; $t = -0.93$; $P = 0.3570$). Negative values are biologically implausible, therefore regression through the origin was indicated. The new regression was also significant ($F = 890.42$; 1,67 df; $P = 0.0001$) indicating that calving site elevation occurs on average at 83% of the high point elevation across all sites. Mean difference between calving site elevation ($\bar{x} = 16.55$; $\pm$ 1.38 [SE]) and high point elevation ($\bar{x} = 19.47$; $\pm$ 1.42) was significant ($P < 0.0001$).

Three small excavations (approximately 20 cm x 10 cm x 5 cm deep) were observed encircling one calving site which was located on a knoll, approximately 150 m from another calving site, located on an adjacent knoll on a large peninsula. One excavation had a strong urine-like odour with signs of liquid recently soaking into the soil (Fig. 2).

DISCUSSION

It has been documented that moose cows will often utilize islands or peninsulas on which to calve, suggesting a predator avoidance tactic (Peterson 1955, Bailey and Bangs 1980, Edwards 1983, Stephens and Peterson 1984). Calving sites in Maine have been characterized as undisturbed and poorly drained areas often dominated by cedar, typically close to water, with small diameter browse species present at the site (Leptich and Gilbert 1986). Moose habitat types encountered in the Maine study were generally dissimilar to those encountered in APP. Habitat types in Maine consisted mostly of level lowland spruce and softwood areas, while those in APP are comprised of a mix of rolling upland hardwood areas interspersed with

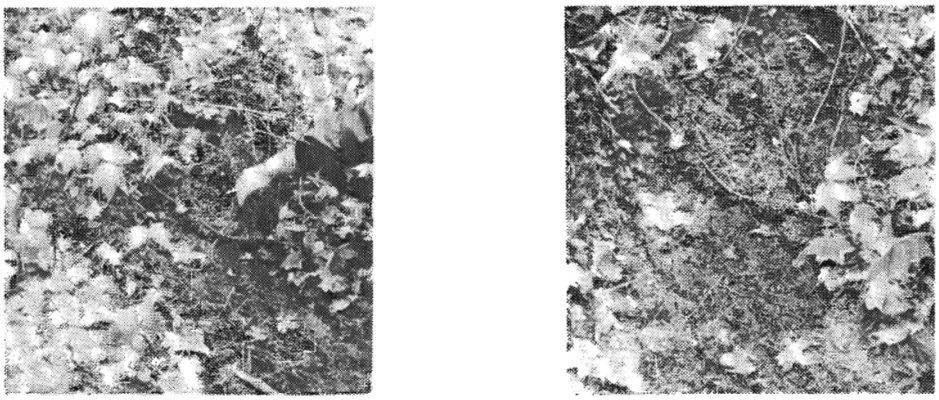

Fig. 2. Scrape made by cow moose near calving site; Burntroot Lake, Algonquin Provincial Park, Ontario.

lowland softwoods and marshes. In addition, while black bear (*Ursus americanus*) predation on moose calves is suspected in Maine, the lack of wolves (*Canis lupus*) is felt to reduce the need for predator avoidance (K.I. Morris and G.R. Lavigne, pers. comm.)

Markgren (1969) felt that the choice of calving sites in Sweden is not dependent upon supply of food or water, but may be ranked as follows: wooded ridge on hill, boggy area, clump of deciduous trees, mature shady coniferous wood, and wooded islet. Addison *et al.* (1990), using different methods of measurement than ours, found that 71% of 54 calving sites were on the upper half (50%) of hills and 41% were on the upper quarter (25%).

It is difficult to relate calving sites to a maximum attainable elevation in the immediately surrounding area, since often slopes rise in step-wise fashion. While many calving sites were not situated right at the highest point of the local and immediately surrounding terrain, often they were situated on a knoll approaching the highest point which afforded easy escape in all directions. In some cases there were knolls distinctly separate from the highest point on an island or peninsula which afforded suitable conditions for more than one cow to utilize as separate, but adjacent calving sites. As well, it appeared that in some instances the highest point of the local and immediately surrounding terrain was not well suited as a calving site because of some physical obstacle such as large boulders, fallen trees or dense underbrush. We did feel however, that in the majority of cases cows were orienting toward elevated locations, where available, which offered clear visibility and escape routes in all directions. We found no calving sites in depressions and only 2 sites close to water level where elevation was available. In the latter instances the same (radio-collared) cow utilized 2 different is lands during 2 successive calving seasons. In 1990 she calved at the low end of a small island remote from a campsite occupied by fishermen and their dog. In 1991 she calved at the low end of a nearby island, once again remote from the campsite. Since the only 2 instances of low calving sites, where adjacent elevation was available, were attributed to the same cow, perhaps this implies aberrant behavior by that cow.

If as indicated in the literature island calving sites are sought by cows to avoid predators, then this implies that water is the deterrent. In that case, islands (being totally surrounded by water) would offer better protection than peninsulas (being surrounded on only three sides). Mainland calving sites adjacent to a shoreline (water on only one side) however, would still be superior to those mainland sites removed altogether from easily accessible water. Figures 3, 4 and 5 illustrate island, peninsula and mainland

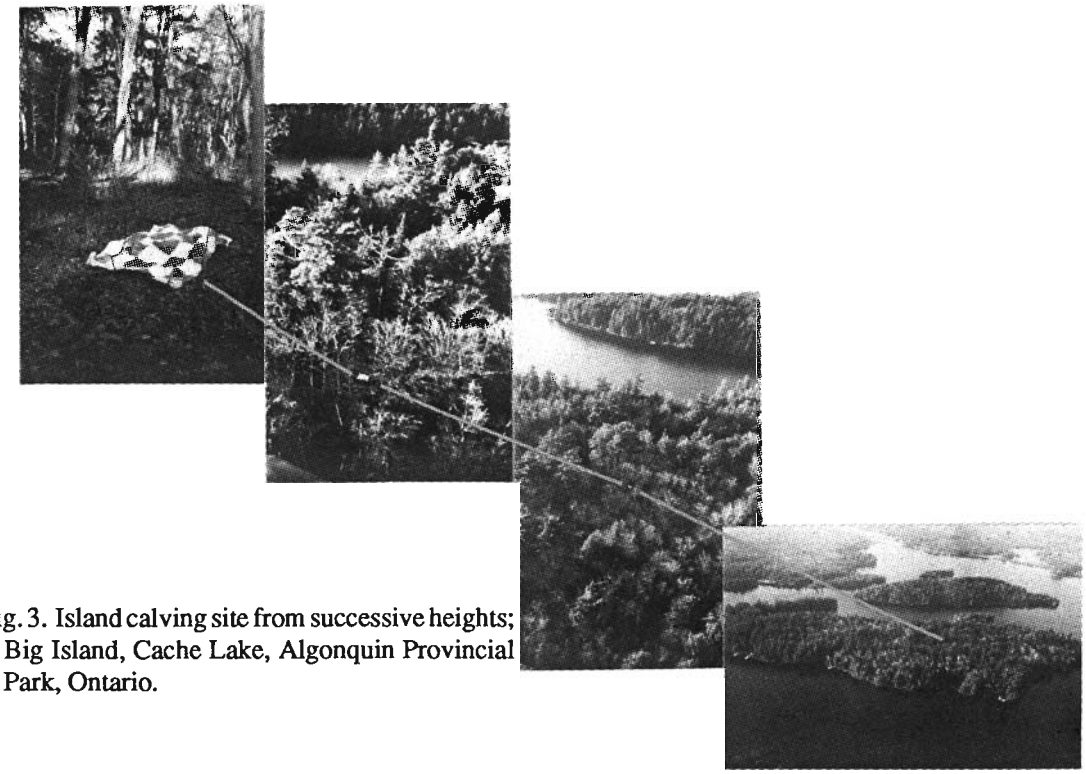

Fig. 3. Island calving site from successive heights; Big Island, Cache Lake, Algonquin Provincial Park, Ontario.

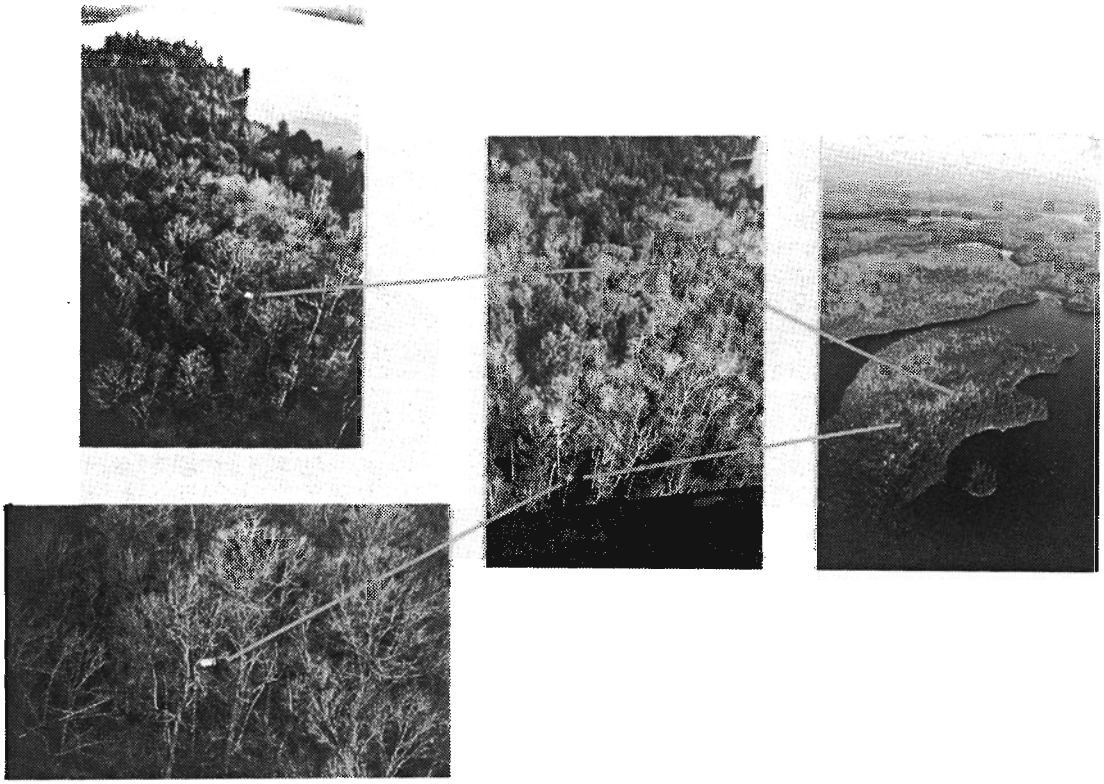

Fig. 4. Two calving sites on adjacent knolls situated along a ridge on a peninsula; Burntroot Lake, Algonquin Provincial Park, Ontario.

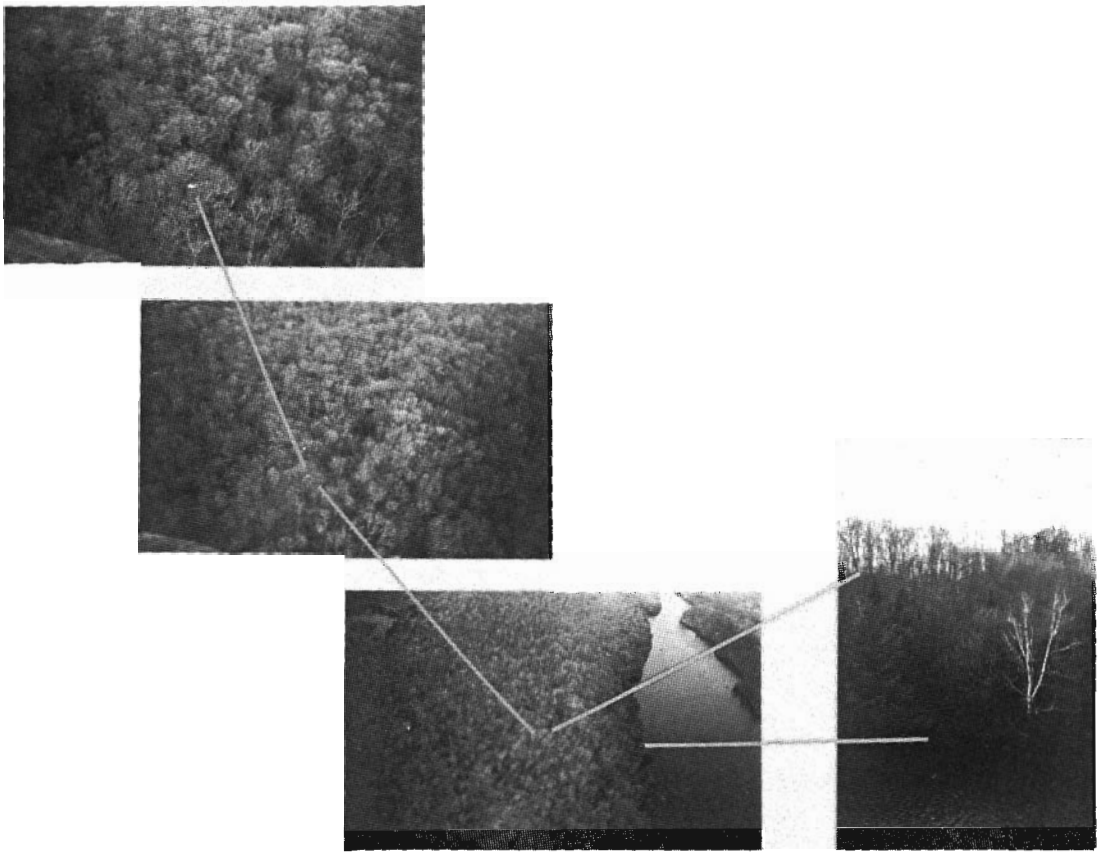

Fig. 5. Mainland calving site showing height above and proximity to adjacent water body; Graphite Lake, Bracebridge District, Ontario.

calving sites respectively.

Prey species will often choose sites which permit the detection of predators by sight, smell and sound. Bedding in more open, elevated areas, without dense concealing vegetation provides a visual advantage over predators (Geist 1980, Smith *et al.* 1986, La Gory 1987). As an example, a bedded cow moose on a knoll with unobstructed visibility perceives the complete image of an approaching predator, but in turn presents virtually no image herself. The same cow bedded in a depression however, presents a complete image to a predator on the hill above her, thus greatly increasing her vulnerability. Further, it is physically and energetically easier for a newborn calf to follow its mother downhill than uphill to escape. While little work appears to have been done concerning the energetics of neonate protection by cow moose, Carl and Robbins (1988) found that lactating mule deer (*Odocoileus hemionus*) (hiders) lost weight during early lactation, while lactating mountain goats (*Oreamnos americanus*) (followers) maintained their weight; the energetic cost to goats of following being borne primarily by the neonate. Since moose calves are primarily followers, early detection of predators is of paramount importance, if escape is to be successfully accomplished with minimal neonate energy expenditure. Thus, cows should prefer elevated areas in which to give birth and subsequently nurse their young.

MANAGEMENT IMPLICATIONS

The Province of Ontario identifies calving sites as areas of concern in Timber Management Planning. Circular "no cut" reserves up to 60 m in radius are generally placed around such areas, insuring that trees will not be felled which may impair a cow's access into or unobstructed view from a known calving site. While the purpose of such reserves is the protection of known calving sites, long term cutting prohibition will result in decadence and ultimate windthrow of protected trees, particularly in elevated areas where winds are strongest. A light "selection cut" which included lopping of all tops to within 1 m of the ground in Sabine Township, Algonquin Park District, resulted in the protection of calving site integrity and re-use of the site the following year. The inference from this is that cutting (timber harvest) may be permissible within calving site reserves, provided extreme care is used to insure that site damage does not occur. This may include such unusual practices as winching harvested trees from the site by cable, horse skidding, and lopping or complete removal of tops. Such treatment may actually prolong the uninterrupted useful life of a calving site, while at the same time allowing the careful harvest of valuable timber products.

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