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MOOSE FATALITY RESULTING FROM OVEREXTENSION OF RANGE

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Abstract: A 2-year-old male moose *(Alces alces)* attempted to winter 500 km north of the tree line, outside of moose range, and died as a result. The dead moose was found in May near the Kazan River at 63°53'N, 95°36'W, Northwest Territories. Analysis of the marrow from the right legs yielded lipid values ranging from 1.12 - 16.9%. Sedges *(Carex* sp.) and willow *(Salix* sp.) were the only components of the rumen contents. Comparison of weather data and the use of wind chill factors and basal metabolic rate demonstrate the physiological improbability of a moose surviving the winter on the open tundra.

INTRODUCTION

The northern limit of the moose has arbitrarily been set as the northern tree line.[3] Their occurrence on the tundra in the District of Keewatin, Northwest Territories, is a rare event.[1]

This is a report on a 2-year-old male moose that died because it could not survive the rigors of winter on the tundra of Keewatin.

DEATH SITE

The moose was first sighted on November 9, 1969, some 30 km west of the death site and seen again during late December.

The carcass was located by E. M. Land on the west bank of the Kazan River at 63°53'N, 95°36'W on May 9, 1970. It was bedded with its back to the prevailing northwest wind about 30 m downgrade on the leeward side of a slope. The terrain was rocky with scattered sedges on snow-free areas along the ridges. This location was about 500 km north or 400 km northwest of the tree line.

The area immediately upstream from the carcass supported an extensive dense stand of willow. The willows were confined to a long narrow strip along the river bank just above the high-water line. It is likely that by mid winter the willows had trapped so much blowing snow that the moose could forage on only a few scattered stems.

METHODS

The moose was brought to Baker Lake, N.W.T. and weighed on a platform scale. The carcass was thawed and a necropsy performed. Mandibles, long bones from the right hind leg and foreleg, and about one litre of rumen contents were collected. The long bones were measured and the marrow from each bone was removed and fixed in 10% formalin.

An alcohol-ether solvent was used to extract the lipids from the marrow.[2] The marrows were weighed, homogenized, and duplicate 2-gram samples from each long bone were processed.

The rumen sample was also fixed in 10% formalin, then washed over a series of Canada Standard Sieves (Nos. 4, 7, 10, and 18) and dried for 48 hours at 60 C. The samples were then weighed,

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and identified with a binocular microscope (70X-250X). Residue from the sieves greater than No. 10 (2 mm) was emptied into a pan and flooded with water. The items were separated with forceps and damp-dried on filter paper. Volumes were then determined by water displacement.

We estimated the age of the moose from the eruption and wear of the mandibular tooth rows as described by Passmore et al.[7] Damaged incisiform teeth were photographed.

Daily climatological summary reports were obtained from Department of Environment, Meteorological Branch. Records from Brochet, Manitoba were used to represent climatic elements within the open boreal forest and the northern range of moose. Weather records for Baker Lake were used for the open tundra of the central Keewatin.

RESULTS AND DISCUSSION

The moose weighed 270 kg and was in poor physical condition. The subcutaneous, kidney and omental fat deposits had been completely utilized. The omentum and the marrow of the long bones were mucoid and hemorrhagic. The analysis of the marrow lipid content of these bones is given in Table 1.

The lungs had numerous areas of alveolar emphysema probably caused by laboured or forced respiration. The liver, spleen, and kidneys had no gross abnormalities. The bladder was distended with approximately 4 litres of urine. The retention of urine was probably the result of the animal being unable to assume its natural position for urination. No evidence of any gross inflammatory process was found in the brain.

Almost 50% of the watery rumen contents passed through a 1 mm mesh (No. 18) sieve. Microscopic examination of one litre of rumen contents revealed that the moose had foraged exclusively on willow and sedges. About 20% of the rumen contents by volume was *Carex*. Sedges are not normally part of the winter diet of moose.[8] We assume that when the willow stands became unavailable the moose turned to foraging for sedges. Although lichens were available on the wind swept slopes they were not utilized.

One of the most interesting aspects of this case history is the damage to mandibular teeth (Figure 1), probably damaged on frozen abrasive materials while foraging for sedges. The apical portion of the crown of the left first incisor was broken off as were portions of the incisal edges of the left second incisor and right first incisor. The glossal surfaces of all incisiform teeth showed extensive hairline fracturing. The edges of the breaks on both the labial and glossal surfaces of the incisors were rounded by attrition, suggesting that the animal had lived for several weeks after tooth damage occurred. The incisal regions of the labial surfaces of the unbroken incisiform teeth

TABLE 1. Long bone statistics for right legs of the winter killed moose found dead on the open tundra in the District of Keewatin, Northwest Territories, 1970.

Bone Sample (Right Side)	Bone Length mm	Marrow Weight g	Lipid Weight g	Lipid Weight %
Femur	440	83.3	0.9	1.1
Tibia	445	127.2	1.6	1.3
Metatarsal	415	45.8	4.2	9.1
Humerus	380	91.3	1.7	1.9
Radio Ulna	470	88.6	1.2	1.3
Metacarpal	360	40.7	6.9	16.9

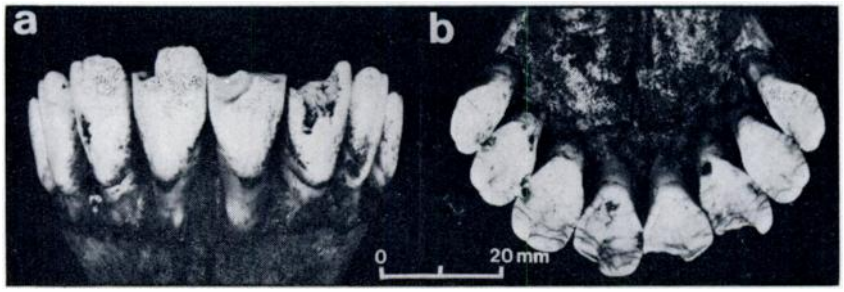

FIGURE 1. Fractured incisors from a 2-year-old male moose that died while wintering on the open tundra of the Keewatin, Northwest Territories, 1969-70: (a) labial and (b) glossal views.

were not cracked. Several hairline fractures were present in the apical regions on the buccal sides of the anterior crescents of the third premolar, fourth premolar, and first molar. The remaining teeth were normal and the mandibles showed no signs of physiological or pathological deterioration.

Even the northernmost wintering range of the moose is a relatively favourable environment compared to the barrens of Keewatin. During the first 90 days of 1970 a total of 48 (53%) had periods when temperatures in the forest exceeded 18 C while only 10 such days occurred on the open tundra. On the tundra gale force winds blew throughout continuous 24-hour periods for a total of 32 days during January, February, and March. Winds of 40 kmph or more blew on 66 of the 90 days (Table 2).

The accumulated loss of heat from January through March is expressed in "Degree-days" (Table 2). Degree-days are estimated by adding or subtracting a threshold value of 0 C from the mean daily temperatures. The impact of wind in association with low temperatures is illustrated by assigning Degree-day credits for each kmph of wind velocity as compiled in Table 2. The minimal compounded effect of the wind and temperature would increase the Degree-days below 0 C to about 3915. The value suggests that the moose was subjected to at least twice as much chilling stress on the tundra as he would have experienced in the boreal forst. Hardy and Stoll[4] found that at —40 C the radiant temperatures of clear skies in the Arctic may be 17 C to 22 C colder than the air temperature. Moen[6] considers nocturnal condi-

TABLE 2. Climatic statistics for Baker Lake, Northwest Territories. Analysis based on "Degree Day" concept and Beaufort scale of winds.

Month 1970	Temperatures Extremes ° C Max.	Min.	Degree Day Below ° C	Wind Speed Monthly Max. kmph	No. Days Aver. >63 kmph	No. Days Aver. >52 kmph	No. Days Exceeding 40 kmph
January	—11	—48	939	93	5	10	23
February	—23	—47	965	127	14	19	22
March	—9	—37	798	121	13	15	20
Aver. for Period	—14	—44	901	114	11	15	22

tions in the open under clear skies as the severest situation for thermal stress upon a deer.

Rate of heat production as determined by basal metabolic rate (Calories = $70W^{3/4}$)[5] suggests that the moose required about 9000 Cal per day. The equation for energy balance — rate of heat production = rate of heat loss ± rate of heat storage — may be used to draw the following conclusions for the moose on open tundra during winter.

(1) Energy maintenance requirements and rate of heat loss were greatly increased.

(2) The potential for heat storage could not be realized because sufficient winter forage was not available.

The occurrence of the moose on the tundra was undoubtedly an expression of "pioneering" instinct in the species. Its failure to acclimate is a good illustration of the variations in adaptations which have resulted from divergent evolutionary development in cervids.

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LITERATURE CITED

1. ANDERSON, R. M. 1924. Range of the moose extending northward. Canadian Field-Naturalist 38: 27-29.
2. ENTENMAN, C. 1957. General procedures for separating lipid components of tissue, Pp. 299-317. *In* S. P. Colowick and N. O. Kaplan (Editors), *Methods of Enzymology,* Vol. 3. Academic Press, New York. 1082 pp.
3. HALL, E. R., and K. R. KELSON. 1959. *The Mammals of North America.* The Ronald Press Co., New York. 2: 547-1083.
4. HARDY, J. D., and A. M. STOLL. 1954. Measurement of radiant heat load on man in summer and winter Alaskan climates. J. Appl. Physiol. 7: 200-211.
5. KLEIBER, M. 1947. Body size and metabolic rate. Physiol. Revs. 27: 511-541.
6. MOEN, A. N. 1968. Surface temperatures and radiant heat loss from white-tailed deer. J. Wildl. Mgmt. 32: 338-344.
7. PASSMORE, R. C., R. L. PETERSON, and A. T. CRINGAN. 1955. A study of mandibular tooth-wear as an index to age of moose, Pp. 223-238. *In* R. L. Peterson, *North American Moose.* Univ. Toronto Press, Toronto. 280 pp.
8. PETERSON, R. L. 1955. *North American Moose.* Univ. Toronto Press, Toronto. 280 pp.

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