# RELATIONS AMONG LINEAR MEASUREMENTS AND WEIGHTS FOR MOOSE (*ALCES ALCES*)

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Abstract: Linear equations were developed from morphometric measurements and whole body weight data of moose immobilized in Saskatchewan and Alberta. Measurements included head length, total length and heart girth. All measurements correlated significantly with weight. The highest correlation was girth$^2$ x length; based upon ease and repeatability of measurement head length was found to be a useful field measurement with which to predict body weight.

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In order to develop a means of estimating moose weights from morphometric measurements, 32 moose captured between October and February were weighed and measured following chemical immobilization for placement of telemetry devices. A simple graph and table are presented which may give operators an opportunity to obtain an assessment of moose weights in the field based on the measurement of head length.

## MATERIALS & METHODS

Free-ranging Alberta and Saskatchewan moose (*Alces Alces andersoni*) were chemically immobilized (Haigh et al 1977). They were then weighed in a sling suspended from a scale attached under a helicopter. The sling was constructed from heavy duty canvas and consisted of two bands of cloth 135 x 25 cm which were passed under the recumbent animal, one band just behind the elbows and the other just anterior to the stifles. Narrow bands 130 x 10 cm of the same material riveted to 1 end of each broad band were passed behind the rump and in front of the shoulders and tied to the opposite side. A 10 cm diameter aspen pole, about 200 cm in length was passed through loops at the ends of the canvas bands and 1.25 cm nylon ropes were tied to the poles and hooked to the scale above the moose's withers (Fig 1). The helicopters used were a Hughes 500C and a Bell 206 Jet Ranger. Weights were read to the nearest 5 kg using a 1000 kg (x 1 kg) scale (Toledo Scale, Madison Hts., Michigan, U.S.A.).

A variety of linear measurements were made with a steel

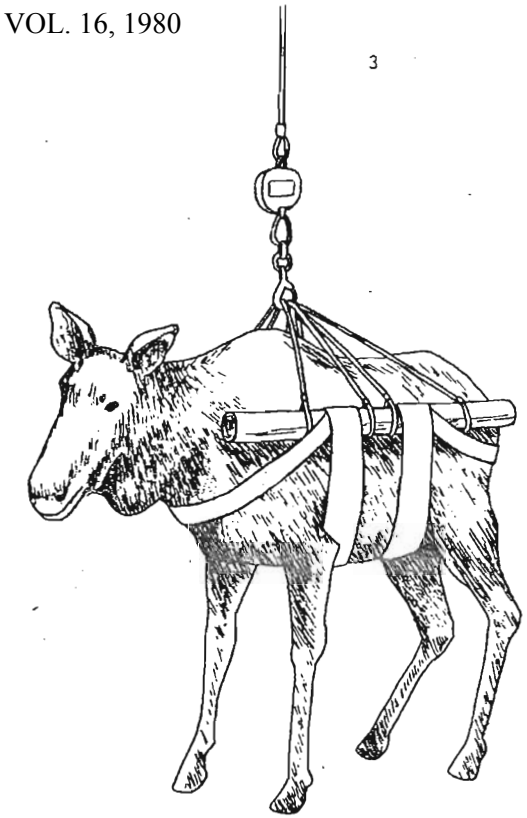

FIGURE 1: Sling arrangement for weighing moose

tape to the nearest 0.5 cm. These included head length (Hl), total length (L) and hearth girth (G). Antler spread was measured in male moose. Head length was measured over the curves from the dorsal border to the planum nasale between the nostrils (Fig 2 inset) to the ridge of the occipital crest (Fig 2).

Male moose weights were corrected downwards to allow for



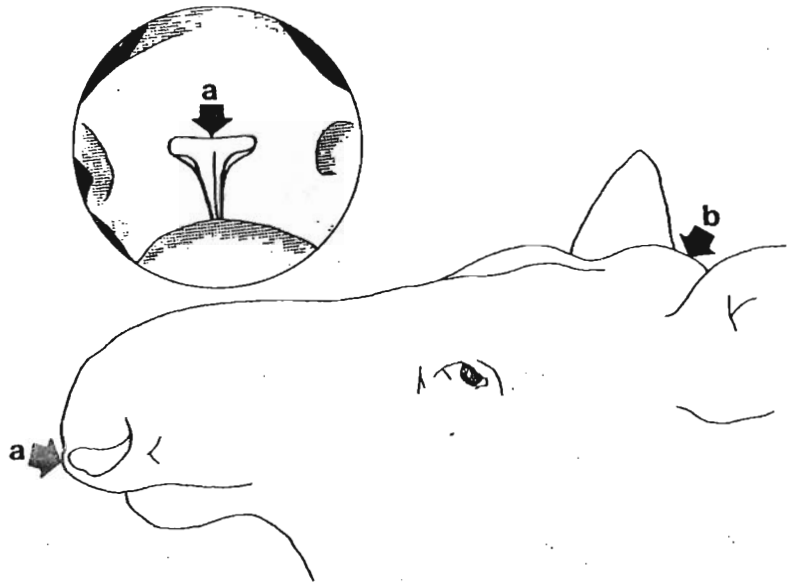


FIGURE 2: Points between which head length (Hl) measurements of moose were made: a) dorsal border of planum nasale b) occipital crest

weight of antlers when present. These corrections, based on antler spread, were as follows: 10 kg for spreads above 110 cm, 5 kg for spreads 80-109 cm.

Fourteen male and 18 female moose were weighed and measured; of these 3 were calves of the year. Eight Alberta moose were weighed in October. Of the Saskatchewan moose, 15 were weighed in December and 9 in February.

Correlation, regression and multiple regression analyses were done for the variables listed using the Statistical Package for the Social Sciences (SPSS) (Nie et al 1975)

## RESULTS

Average whole weights for adult moose (> 36 months, Franzmann et al 1978) were for 6 males 527 kg (range 475-570 kg) and for 12 females 422 kg (325-515 kg).

There were insufficient data points to permit meaningful analysis of differences between sex, age, location and season. All linear measurements correlated significantly with weights as indicated in table 1.

Table 1: Linear Correlations Between Body Measurements and Whole Moose Weights

| Parameter | r | Linear Equation | F | Standard Error |
|---|---|---|---|---|
| Total length | .71 | y=-283.77+263.85xL | 31.7** | 46.8 |
| Girth | .87 | y=-494.25+499.3xG | 96.0** | 48.9 |
| $Girth^2$ | .86 | $y=-41.5+125.9xG^2$ | 86.2** | 13.6 |
| $Girth^2$ x length | .91 | $y= 47.8 + 38xG^2L$ | 143.3** | 37.6 |
| Head length | .88 | y=-344.3+1053.5xHl | 95.45** | 46.0 |

** All F values significant at $p < 0.01$



A regression line based on the equation for head length is presented in Figure 3. Table 2 provides head length and weight figures in 10 kg steps based on this equation.

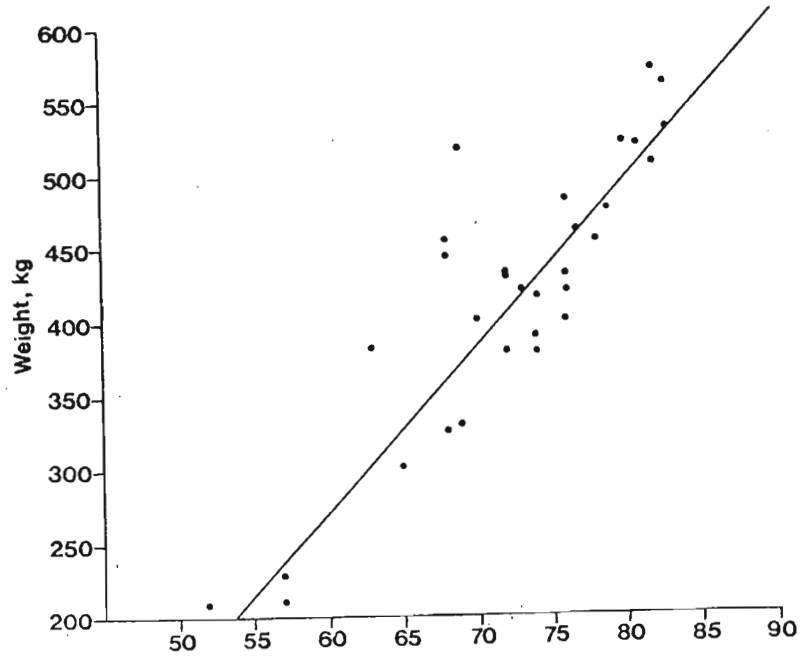


FIGURE 3: Regression of weight (Wt) in kg on head length (Hl) in cm for moose.

Table 2: Ten kg weight (Wt) steps for moose calculated from head length (Hl) in cm.

| Wt | Hl | | |
|---|---|---|---|
| 200 | 54.0 | 400 | 71.5 |
| 210 | 55.0 | 410 | 72.5 |
| 220 | 55.5 | 420 | 73.0 |
| 230 | 56.5 | 430 | 74.0 |
| 240 | 57.0 | 440 | 75.0 |
| 250 | 58.0 | 450 | 76.0 |
| 260 | 59.0 | 460 | 77.0 |
| 270 | 60.0 | 470 | 78.0 |
| 280 | 61.0 | 480 | 78.5 |
| 290 | 62.0 | 490 | 79.5 |
| 300 | 62.5 | 500 | 80.5 |
| 310 | 63.5 | 510 | 81.5 |
| 320 | 64.5 | 520 | 82.0 |
| 330 | 65.0 | 530 | 83.0 |
| 340 | 66.0 | 540 | 84.0 |
| 350 | 67.0 | 550 | 85.0 |
| 360 | 68.0 | 560 | 85.5 |
| 370 | 69.0 | 570 | 86.5 |
| 380 | 70.0 | 580 | 87.5 |
| 390 | 70.5 | 590 | 88.0 |
| | | 600 | 89.0 |

## DISCUSSION

A variety of devices has been used to weigh moose in the field (Blood et al 1967, Arneson & Franzmann 1975). Correlations between weights and linear measurements for many species have regularly been found to be significant (Franzmann et al 1978, Freeman & King 1969, Blood et al 1967, Karns, 1976).

Data from this study indicates that the girth squared provides the best estimate of body weight as evidenced in Table 1. The standard



error of the estimate for the girth squared is 13.6 kg, whereas that for other measurements ranges from 37.6 (girth squared times length) to 48.9 kg in the use of girth only.

The small amount of data reported herein precludes its use in any way other than as a simple field technique for estimation of moose live weights. The inaccuracies likely to occur between persons measuring animals in the field will be multiplied both where more than one measurement is required and where a measurement over areas of heavy pelage and "over the curves" requires the tape to be held or moved in a series of steps such as occurs over a total length measurement. Leg length or height at the shoulder (Peterson 1974) may be a difficult measurement to reproduce consistently. It will vary not only according to the animal's position but its degree of relaxation if recumbent and the use of the tape either over the curves or in a straight line. The ease of measuring head length between two well-defined points with a minimum amount of hair cover justified the use of this parameter despite its relative shortness. This may account for the fact that head length/weight had a high correlation coefficient. Furthermore, the measurement of this parameter is simpler and quicker than any of the others.

Deductions of antler weight based on spread are only a practical field method. They will be prejudiced by variations according to both antler width and the animal's age. As whole weight measurements are only gauged within 5 kg the deductions for antler weight used are within acceptable limits.

Disadvantages implicit in this technique are that it takes no account of differences in body condition (such as might occur with subcutaneous fat deposition in girth measurements) and in particular of rumen fill which may account for substantial proportions of a ruminant's weight, and may vary according to season and availability of feed. Extreme variations in moose weights according to season have been reported (Franzmann et al 1978).

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