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Expanded abstract

Estimating body composition of caribou and reindeer using bioelectrical impedance analysis and body condition scores

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The use of non-destructive methods to assess body composition of wild cervids allows clarification of the dynamic influence of the environment on nutrient reserves which, in turn, affect reproductive success. Both bioelectrical impedance analysis (BIA) and body condition scores (BCS) have been used elsewhere to estimate *in vivo* body composition. BIA relies on the differential conductivity of lean and fatty tissues, while BCS are numerical indices of overall condition. This is a preliminary report on the efficacy of BIA and BCS as predictors of fat content (FAT) and total body water (TBW).

Nine captive male reindeer and 10 wild female caribou of the Central Arctic Herd (CAH) were used in this analysis. An additional 5 female caribou of the CAH were rated using BCS only. Each animal was weighed (BW, nearest kg), and body measurements (body length, L, chest girth, G, metatarsal length, MT, all in cm) were taken. Whole body resistance (Z) was determined using a bioelectrical impedance analyzer (BIA-101A, RJL Systems, Inc., Detroit MI) and 2 pairs of electrodes which were inserted under the skin at each of 2 sites (Fig. 1): on the legs with the animal lying on its side (Z_L), and along the back with the animal lying on its chest (Z_b). BCS was determined as the sum of numerical rating (1-5, 1 being low) of the amount of soft tissue covering bone at each of 3 sites: withers, ribs, and hips. A body reserve index (BRI) was computed as the product of BCS and body weight. All animals were killed and processed for chemical analysis (Huot and Picard 1988). Water content was determined by freeze drying; fat content was determined by petroleum ether extraction.

Stepwise linear regression was used to examine relationships between dependent (TBW, liters, and FAT, kg) and independent variables (BCS, BW, BRI, MT, L, G, $1/Z_b$, $1/Z_L$, (MT or L)$^2/Z_L$ or Z_b). Impedance values were expressed as (length)$^2/Z$, since body water volume is theoretically related to conductor length squared divided by resistance.

Correlation between TBW and body weight (eq. 1) was stronger than that between TBW and any impedance term. Impedance expressed as L^2/Z_L was most strongly correlated with TBW (eq. 2). TBW was not correlated with Z_b.

[1] TBW = 19.1 + 0.5 * BW ($n=18$, $r^2 = 0.95$, $P<0.0001$)

[2] TBW = 34.3 + 0.2 * L^2/Z_L ($n=18$, $r^2 = 0.78$, $P<0.0001$)

FAT was strongly correlated with BRI (eq.

3), and body weight (eq. 4), but was weakly correlated with L^2/Z_L (eq. 5).

[3] FAT = -4.9 + 0.02 * BRI (n=24, r^2 = 0.85, $P<0.0001$)

[4] FAT = -14.2 + 0.2 * BW (n=24, r^2 = 0.78, $P<0.0001$)

[5] FAT = -6.3 + 0.1 * L^2/Z_L (n=18, r^2 = 0.56, $P<0.001$)

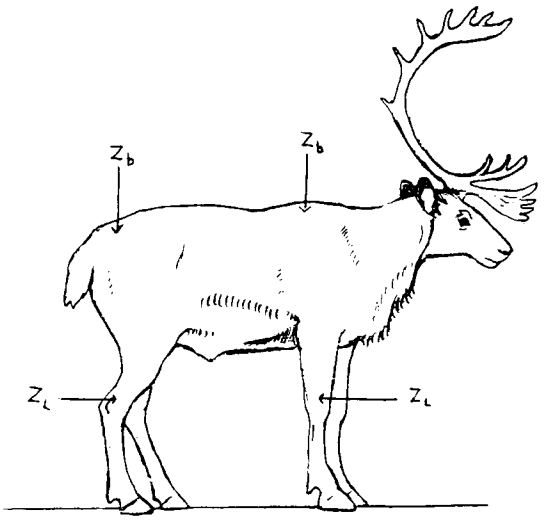

Figure 1. Placement of electrodes for bioelectrical impedance analysis. Impedance was determined in 2 positions: With a pair of electrodes on the front and hind leg and the animal lying on its side (Z_l), or with a pair of electrodes at 2 sites along the back and the animal lying on its chest (Z_b)

Body length and metatarsus length differ between *Rangifer* sub-species, and may have influenced the impedance values: Z_b values were similar for caribou and reindeer, but Z_L values formed 2 discrete populations, one for each subspecies. While including body measurements in prediction equations may, in part, correct for effects of frame size, population-specific prediction equations may be necessary for BIA.

Body condition indices are a more useful indicator of body composition than BIA. BRI was highly correlated with body fat in both sub-species, and was a superior predictor of body fat (mean standard error of the estimate 0.4 kg). BIA values were strongly correlated with TBW; however, body weight was superior to BIA as a predictor of TBW. BIA, therefore, may not be a preferred method of estimating body composition of caribou and reindeer.

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References

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