

The relationship between kidney fat index and marrow fat percentage as indicators of condition in Red deer stags (*Cervus elaphus*)

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The level of fat reserves of an animal gives a good indication of body condition. Riney (1955) who studied various methods of evaluating condition in Red deer in New Zealand considered that fat was deposited in a pre-determined sequence over the range of body weight studied, which had been described earlier by Hammond (1932) as a general sequence in farm animals. Fat was deposited firstly in the bone marrow, then around the kidney, and finally subcutaneously. He concluded that kidney fat, expressed as a percentage of kidney weight, was the best index of condition as it embraced almost the entire range of physical condition. However, several authors have noted that small areas of fat are found around the kidneys of starved animals with marrow fat percentages $< 80\%$ (Ransom, 1965; Brooks, Hanks & Ludbrook, 1977; Anderson, Medin & Bowden, 1972). This means that values for kidney fat index of below $< 40\%$ may not be reliable, as another fat store, the marrow fat is depleted in parallel with it and not after it as Riney (1955) suggested. The relationship between kidney fat index and marrow fat at low levels of kidney fat index has been shown for White tailed deer *Odocoileus virginianus* (Ransom, 1965), Eland *Taurotragus oryx*, Impala (*Aepyceros melampus*) and Cape buffalo (*Syncerus caffer*) Brooks *et al.*, 1977 and Mule deer *O. hemionus* (Trainer, Hartmann & Kistner, 1979) but has never been shown for Red deer. The aim of this study was to accomplish this.

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Materials and methods

During September and October 1978 and 1979 prior to the rut the left metacarpus and both kidneys and surrounding fat were removed from 15, 27 and 75 month old farmed Red deer stage (Table I) slaughtered as part of other studies at Glensaugh Deer Farm, Kincardineshire.

The kidney fat index was calculated using the method of Riney (1955) and the metacarpal marrow fat was analysed chemically by the method described by Atkinson, Fowler, Garton & Lough (1972).

TABLE I
Stags used in this study

Group	<i>n</i>	Age at slaughter	Symbol on Fig. 1	Brief history
A	27	15 months	○	Born Glensaugh 1978, Inwintered 1978–1979, on reseeded upland pasture May 1979 until slaughter September 1979
B	9	15 months	▲	Born Fasque 1977. Zero grazing trial Summer 1978. Slaughtered September 1978
C	11	15 months	■	Born Glensaugh 1977. Inwintered 1977–1978 on unimproved hill pasture until slaughter September 1978
D	9	27 months	□	As above but slaughtered September 1979
E	1	27 months + 75 months	●	Surplus breeding stags, shot at Glensaugh October 1978

Results

Percentage marrow fat is plotted against kidney fat index in Fig. 1. Distinctions for age groups are as for Table I. There were no significant ($P > 0.05$) differences between the stags due to age in either kidney fat index or marrow fat index. The relationship holds for all age classes studied. (Each age class was compared with the age class immediately preceding, using an unpaired two tailed *t*-test. If no significant differences were detected, the data were lumped and the next preceding age class was compared in the same way with the combined age classes. This was continued until no significant differences had been detected between any age classes.)

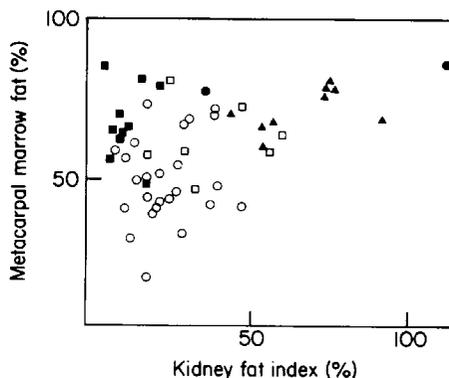


FIG. 1. The relationship between metacarpal marrow fat and the kidney fat index for Red deer stags. The symbols are as explained in Table I.

The results indicate that the fat content of the metacarpal marrow varies little above a kidney fat index of 50, but below this threshold value fat content of the marrow tends to decrease as kidney fat index decreases.

Discussion

Kidney fat index is not a reliable measure of total body fat reserves in Red deer below a value of 50 and changes in marrow fat content must also be considered. This has been most elegantly dealt with by Trainer, *et al.*, (1979) who calculated a condition index for Mule deer comprising both kidney and marrow fat indices.

Throughout the present study metacarpal marrow fat was studied rather than femur marrow fat. Although the metacarpal fat is a less sensitive indicator of condition than the femur fat (Brooks *et al.*, 1977) it is readily available as offal and so does not necessitate damaging a carcass.

A less sensitive indicator was used in the present study and this then may explain why the threshold was 50% and not 20–30% as in other studies, for example, Ransom (1965).

The poor relationship between kidney and marrow fat indices below a 50% kidney fat index is possibly because depots of fat are not depleted or deposited in precisely the same sequence in all animals. Some animals may use up all their kidney fat before beginning to deplete their marrow fat while others deplete both sources in parallel.

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