

Expanded abstract

Dominance relationships among female semi-domesticated reindeer: the function of antlers

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Dominance relationships among female semi-domesticated reindeer (*Rangifer tarandus tarandus* L.) were studied in the experimental herd of the Association of Reindeer Herding Co-operatives in Kaamanen (69°10' N), Northern Finland, in winter 1989-90. A total of 24 pregnant females were divided into three equal groups according to age, body weight and antler size and placed into corrals in mid-December 1989. The reindeer had been grazing freely on natural pastures six months prior to this. A number of antler and body measurements were made on the reindeer at the beginning of the experiment, and they were then weighed weekly and the feed consumption of the groups (fed *ad libitum*) was measured daily.

The groups were manipulated as follows: Group 1, control, all retained their antlers throughout; Group 2, antlers were removed from all the reindeer at the same time; Group 3, antlers were removed at three-day intervals, beginning with the most dominant reindeer. Social rank order and all changes in dominance relationships within the groups were assessed by intensive observation. The social rank of each animal was denoted by the number of which she dominated in her group.

Dominance relationships had already been established in the groups prior to the start of observations at the beginning of January. No fights were seen during the period when all the reindeer had antlers, but the subordinate reindeer were often targets of aggression, mostly head nodding (often with a snort), approaching head down with ears back, butting with the antlers, kicking with the forelegs, and chasing.

The rank order in the groups differed from an ideally linear organization, but the hierarchies of all three groups nevertheless showed a clear linearity when calculated according to Appleby (1983). A correlation coefficient matrix showed many of the variables to correlate each other. Variance in rank and antler measurements were clearly explained by the first component in principal components analysis, and variance in body measurements and age by the second and third components. A more exact evaluation of the relationships between the various measurements showed that the social rank of reindeer correlated with age up to five years ($r=0.82$, $P=0.0006$, $N=13$), but not after that ($r=0.14$, $P=0.67$, $N=13$). It was thus justified to divide the animals into two age categories for the statistical tests, whereupon rank was

seen to correlate with body weight better among those ≥ 6 yrs ($r=0.80$, $P=0.003$, $N=11$), than among those ≤ 5 yrs ($r=0.42$, $P=0.15$, $N=13$). The relationship between body weight and rank gradually disappeared as the reindeer gained weight. Rank correlated with antler weight among both the younger animals (≤ 5 yrs) ($r=0.85$, $P=0.0002$, $N=13$) and the older ones (≥ 6 yrs) ($r=0.74$, $P=0.009$, $N=11$), and was correlated with mean antler height in both age groups (≤ 5 yrs: $r=0.66$, $P=0.013$, $N=13$; ≥ 6 yrs: $r=0.71$, $P=0.015$, $N=11$).

None of the body measurements alone correlated with rank, but the correlation between the calculated index of body size and rank showed that the antlered individuals that gained more body weight in relative to height were of high rank. There was no significant correlation between age and antler weight ($r=0.30$, $P=0.15$, $N=24$), but body weight at the beginning of the experiment showed a positive correlation with antler weight ($r=0.46$, $P=0.02$, $N=24$). The lower a female was in rank order the more often it was harassed in its group.

Antler removal caused fights and changes in dominance in the two groups, which were not observed in the antlered group. Fighting between deantlered individuals took the form of "boxing", in which it was not advantageous to be of an especially heavy build. Age was the only variable which correlated with rank in the two deantlered groups.

Almost linear hierarchies are common in groups of *Cervidae* (see Espmark 1964, Hall 1983, Barrette & Vandal 1985), and social factors and chance may be important factors in establishing these hierarchies as well as fighting and competition ability. Once the hierarchy among reindeer females in a permanent group is established it is quite stable and fights are rare. Age, body weight or antler size have been linked earlier with social status among reindeer (Espmark 1964, Barrette & Vandal 1985, Kojola

1989) and also red deer (*Cervus elaphus* L.) (Hall 1983, Clutton-Brock *et al.* 1984). It seems from the present observations that antler size is an especially important factor determining dominance between female reindeer. The results support the hypothesis that intra-herd competition in winter may have favoured antler development in female reindeer (see Espmark 1964, Henshaw 1968, Barrette & Vandal 1985).

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