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# Effect of roe buck removal on marking intensity

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An experiment was performed in a roe deer *Capreolus capreolus* (Linnaeus, 1758) population to assess the effect of a large-scale removal of adult males on the intensity of marking behaviour. Rubs and scrapes were censused in two 150-ha areas, one experimental and one control, in southeastern Sweden in May 1991 and 1992. In the experimental area, 14 males (50% of total number, 11 ≥ 3 yrs) were culled during mid-August 1991. Removed males were replaced by the following season. Despite this, the number of scrapes, but not the number of rubs, was significantly fewer in the experimental area in May 1992 as compared to the control. This reduction could be due to a late arrival of replacement males, which would explain why the reduction involved scrapes rather than rubs, as scraping activity starts several weeks before rubbing. To cull adult males between territorial seasons is thus not an effective way to reduce rubbing intensity, and hence damages, on young forest plantations.

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## Introduction

Mature male roe deer *Capreolus capreolus* (Linnaeus, 1758) are territorial from early spring (March–April) until the rut is over in late August-early September (eg Bramley 1970, Strandgaard 1972, Kurt 1991). Roe bucks become physiologically mature as yearlings, but do not usually defend territories until 3 to 4 years, depending on the demography of the population (Bramley 1970, Strandgaard 1972, Kurt 1991). During the territorial season, males perform two types of marking behaviour: pawing the ground with the front hooves, termed scraping, and rubbing antlers and forehead against stems of trees and bushes (termed fraying/rubbing). Both types leave conspicious marks, and probably also facilitate olfactory communication as roe deer possess skin glands both on the head and between the digits of the hooves (Raesfeld *et al.* 1985). Scraping activity commences in March at the latest, and peaks in April (Johansson *et al.* 1995) or May (Davies and Davies 1968, Sempéré *et al.* 1980). Rubbing starts later, by the beginning of April, and increases sharply during the second half of this month (Johansson *et al.* 1995). Both scraping and rubbing continue throughout the territorial season and cease by September, after the breeding season (Sempéré *et al.* 1980, Johansson *et al.* 1995). The function

of the two types of markings is disputed, and suggestions include territorial marking, display, self-orientation, and communication to males and females (Strandgaard 1972, Sempéré *et al.* 1980, Kurt 1991, Johansson *et al.* 1995).

An aspect of great economic importance is the considerable damage that might result from frequent rubbing, especially in young plantations. A thorough understanding of the function underlying marking behaviour is critical if we want to minimize damage. In an attempt to gain such an understanding, Cumming (1966, 1974) compared different shooting regimes during one territorial season and observed substantially more rubbed trees in areas where territorial males were removed and non-territorials were left than vice versa.

The aim of the present study was to investigate how marking intensity was affected by a large-scale removal of primarily adult (≥3 yrs old) male roe deer between two territorial seasons. In May, for two consecutive years, I compared the number of rubs and scrapes in an experimental area in which culling was performed at the end of the first year's territorial season, with a nearby control area with no shooting.

## Study area and methods

The study was carried out at Bogesund (59°24'N, 18°12'E) in southeastern Sweden in 1991 and 1992. The study area is 2500 ha and is dominated by commercial coniferous and mixed forests (ca 70%), the rest being agricultural land. Dominant tree species are Scots pine *Pinus sylvestris*, Norway spruce *Picea abies*, birch *Betula* spp., and oak *Quercus robur*. The climate is characterized by warm and relatively dry summers and moderate winters with snow normally occurring during December–March. However, both winters preceding my censuses were unusually mild with little or no snow. The population of roe deer is free-ranging and was protected from hunting from 1988. Population densities were 31 deer/km$^2$ in 1991 and 28 deer/km$^2$ in 1992 (Wahlström and Liberg 1995).

I conducted the study in two forested 150-ha areas, one experimental and one control, separated by a buffer zone of 400–2000 m. Adult male roe deer have been shown to be highly stable geographically (Bideau *et al.* 1993), and at Bogesund males occupy ranges of 20–50 ha (Cederlund *et al.* 1993, Wahlström and Kjellander 1995). I could thus be satisfactorily certain that males did not inhabit both areas, also supported by studies of radio-marked animals. The habitat in the two areas was similar, consisting of mature timber stands, thinned middle-aged forests, dense plantations, clearings with deciduous shrubs, and bogs. In both areas, the population was composed of marked as well as unmarked males (Table 1). The numbers and age composition of the latter were determined from observations made in April and constitute minimum estimates as some individuals may always remain concealed in forested habitats.

In the experimental area, 14 unmarked males were selectively culled by stalking in mid-August 1991. Shot males were aged by comparing their jaws with known age material (Cederlund *et al.* 1991). Eleven males were ≥3 years old, 2 were subadults (2 yrs), and 1 was a yearling. A minimum of 14 males remained in the area after the shooting, 10 of which were radio-marked (Table 1) and 4 unmarked (1 adult, 1 subadult, and 2 yearlings). Hence, a minimum of 28 males had inhabited the experimental area before culling, which agrees with the estimated 26 in April (Table 1). An additional 8 males (5 adults and 3 subadults) were culled just outside (150–850 m) the experimental area. No culling was performed in the control area.

Rubs and scrapes were censused in 600 plots (each 40 m$^2$), 300 in the control and the experimental area respectively, distributed every 50 m along north-south transects 100 m apart. I censused during

May 13–23 in 1991 and May 11–21 in 1992, alternating from day to day between transects in the control and the experimental areas. I used chi-squared tests to compare frequencies of marking between years and areas, and to test if the number of males in the area (in April) differed the year before and and after culling.

## Results

There was no difference in the number of males in the area in April 1991 and 1992, ie before and after culling ($\chi^2 = 0.13$, df = 1, $p = 0.720$; Table 1). The number of scrapes, however, decreased in both areas after the experimental removal of males (Table 2), but the decrease was significantly larger in the experimental area (48%) than in the control area (16%). Also the number of rubs decreased in both areas (32% and 21% respectively), but the decrease did not differ significantly between the two areas (Table 2).

Table 1. Number of male roe deer of different age categories in the experimental- and control areas at Bogesund in April 1991 and 1992. The number of unmarked males constitute minimum estimates. a – for unmarked males, 2-year-olds were not separated from adults.

| | Experimental area | | | | Control area | | | |
|---|---|---|---|---|---|---|---|---|
| Males | Ad | 2 yrs | 1 yr | Total | Ad | 2 yrs | 1 yr | Total |
| 1991 | | | | | | | | |
| Marked | 3 | 3 | 4 | 10 | 4 | 1 | 4 | 9 |
| Unmarked | 12 | a | 4 | 16 | 5 | a | 1 | 6 |
| Total | 15 | 3 | 8 | 26 | 9 | 1 | 5 | 15 |
| 1992 | | | | | | | | |
| Marked | 5 | 3 | 1 | 9 | 3 | 3 | 2 | 8 |
| Unmarked | 8 | a | 5 | 13 | 5 | a | 2 | 7 |
| Total | 13 | 3 | 6 | 22 | 8 | 3 | 4 | 15 |

Table 2. Number of scrapes and rubs censused in the experimental and control areas at Bogesund in May 1991 and 1992. Fourteen roe deer males (11 adults, 2 subadults, and 1 yearling) were culled in the experimental area in mid-August 1991.

| Marking | Area | 1991 | 1992 | % change between years | $\chi^2$ | $p$ |
|---|---|---|---|---|---|---|
| Scrapes | Experimental | 100 | 52 | –48 | 4.03 | 0.045 |
| | Control | 80 | 67 | –16 | | |
| Rubs | Experimental | 37 | 25 | –32 | 0.19 | 0.662 |
| | Control | 38 | 30 | –21 | | |

## Discussion

The reduced number of scrapes in the experimental area was in contrast to the increased number of scrapes observed by Davies and Davies (1968) after 4 males were culled in early May. Similarly, Cumming (1966, 1974) observed an increased number of rubs when males were removed within one territorial season. Davies and Davies (1968) do not mention the status of culled males, whereas Cumming (1966, 1974) knew he removed territorial males. In the present study, it is likely that shot males $\geq 3$ years old were territorial because all marked male roe deer in both Bogesund and the nearby Ekenäs area were territorial from the age of 3 years (Cederlund and Liberg 1995). The discrepancy between mine and Davies and Davies' (1968) and Cumming's (1966, 1974) results could be explained by the difference in timing of male removal.

When territorial males are removed early in the season, vacated territories are filled promptly (usually within 24 hrs, Loudon 1978). Newcomers have to recommence marking the area, in contrast to males that maintain an already established and marked territory. In addition, a replacement male might even be stimulated by the remaining marks of the predecessor, and therefore mark more intensively than a male who is the first occupant. When males, on the other hand, are removed late in the territorial season, vacated territories are usually not filled until the following spring (Loudon 1978). Cederlund *et al.* (1993), who used the same removal experiment to study effects on the spatial behaviour of roe deer at Bogesund, observed no movements into the experimental area during the months following the cull. The subsequent season, however, resident males were replaced, probably by immigrating males as no marked male moved into the experimental area (Cederlund *et al.* 1993).

The reduction in number of scrapes could be explained by a delay before territory establishment in the experimental area in 1992 compared with the previous year. It is possible that replacement males were not present in the area in late winter, unlike males reestablishing territories, but moved in later. If replacement males arrived even a few weeks later than normal, they would not participate in the same number of weeks of marking activity, resulting in a lower total number of markings in May. This could also explain why the reduction was larger for scrapes than for rubs, as scraping activity starts several weeks before rubbing (Johansson *et al.* 1995).

The overall tendency for fewer markings the second year could be an effect of that the population showed several signs of being close to carrying capacity in 1992 (Wahlström and Liberg 1995), with high juvenile mortality and low female fecundity. Reduced viability in males relative to females when subjected to high population density has been reported in eg red deer (*Cervus elaphus*; Clutton-Brock *et al.* 1982, 1985), and recent studies indicate that this applies also to roe deer (Gill 1994, Vincent *et al.* 1995). Hence, males in my population may have been in

relatively poorer condition in 1992 than in 1991, which may have resulted in a reduced or delayed marking activity.

The results from this experiment suggest that removing adult male roe deer from an area between territorial seasons is not an effective way to reduce rubbing damage on young forest plantations, especially in dense populations with strong competition for territories, where all removed males are replaced the following season.

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