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SITE FIDELITY OF MALE ROE DEER IN A MEDITERRANEAN FRAGMENTED AREA

CLAUDIA MELIS, FRANCESCA CAGNACCI, SANDRO LOVARI

Department of Environmental Sciences, Sect. of Behavioural Ecology, Animal Behaviour and Wildlife Management, University of Siena, via P.A. Mattioli 4 - 53100 Siena - Italy. Tel: +39 0577 232955/954. E-mail: lovari@unisi.it (corresponding author)

ABSTRACT - We present data on site fidelity based on 7 adult male roe deer *Capreolus capreolus* (L.), which were studied for two years (March 1999-February 2001) by radiotelemetry. The median site fidelity of roe deer between year 1999-2000 and 2000-2001 was 63%. Throughout the year 2000, the analysis of distance between core areas (50% kernel) centres revealed 2 tactics of habitat use by adult males: "annually site-faithful" males, who occupied the same home range over the year and "seasonally site-faithful" males, who moved to a different area during the cold months. Being resident throughout the year could privilege territory holders, already present at the beginning of the territorial season in respect to late-coming males. This supports the view of the "always stay" territorial behaviour, as a "low risk-low gain" strategy maximizing high survival and long tenure.

Key words: *Capreolus capreolus*, spatial behaviour, site fidelity, territoriality

RIASSUNTO - ***Fedeltà al territorio dei maschi di capriolo in un'area mediterranea frammentata***. Sette maschi adulti di capriolo *Capreolus capreolus* L. sono stati seguiti per due anni, dal Marzo 1999 al Febbraio 2001, con metodi radiotelemetrici. La sovrapposizione mediana degli home range (fedeltà), fra il 1999-2000 e il 2000-2001, è risultata del 63%. Nel corso del 2000, l'analisi della distanza fra *core area* (50% kernel) ha rivelato due tattiche di uso dello habitat: "maschi fedeli annualmente", che hanno occupato lo stesso *home range* durante tutto l'anno, e "maschi fedeli stagionalmente", che si sono spostati in un'area diversa durante i mesi freddi. Essere residente per tutto l'anno potrebbe risultare vantaggioso per i maschi che si trovino già sul posto all'inizio della stagione territoriale, rispetto a maschi che abbiano trascorso l'inverno altrove. Questi risultati concordano con la teoria che i caprioli adottino un comportamento territoriale "permanente", come parte di una strategia a "basso rischio e basso guadagno", volta a ottimizzare la sopravvivenza e la durata della vita riproduttiva.

Parole chiave: *Capreolus capreolus*, comportamento territoriale, fedeltà al territorio, uso dello spazio

INTRODUCTION

The European roe deer *Capreolus capreolus* L. is an obligate territorial Cervid (Owen-Smith, 1977). Territories are established by adult males in spring and maintained throughout summer, while in the cold season roe deer form groups to feed in open fields, where available (Bideau *et al*., 1985; Kurt, 1968; Zejda, 1978; Maublanc *et al*., 1987; Cibien *et al*., 1989; San José *et al*., 1997, Hewison *et al*., 1998). Most males show lifetime fidelity to the area where they established their first territory (Bramley, 1970; Ellenberg, 1978; Johansson and Liberg, 1996; Linnell and Andersen, 1998), but males can migrate in winter to have access to areas of high food abundance (Linnell and Andersen, 1998; Mysterud, 1999). In a mountainous habitat, in Italy, males showed a great individual variability in seasonal spatial behaviour (Rossi *et al.*, 2003). Adult roe deer (from two years old) can mate with one or several females per year, and their territorial system could therefore be a long term investment, in which the reproductive success is divided amongst several years. Thus, survival and tenure would be privileged (Linnell and Andersen, 1998). The territorial system of roe deer is supposed to be analogous to defence resource polygyny (*e.g.* Liberg *et al.*, 1998; Linnell and Andersen, 1998). Greenwood (1980) maintained that male birds, with a mating system of resource defence, should be more philopatric than females, while male mammals, with a mating strategy of mate defence, should be less philopatric than females. This is true both for natal and breeding dispersal (cf. Linnell and Andersen, 1998, for roe deer in Norway). Data on site fidelity and seasonal migration of male roe deer have never been reported for the Mediterranean region. Our study area is rich of food, i.e. cultivations, throughout the year and climate is mild. Therefore, we would expect a different pattern with respect to Scandinavia, where migrations have been reported (Linnell and Andersen, 1998; Mysterud, 1999). In this paper we investigate male site fidelity within the same year to see whether males occupy territories that can satisfy their energetic requirements throughout the year or whether they shift home ranges between the territorial and non-territorial seasons. We also evaluated site fidelity in different years to test how stable the territorial system is.

STUDY AREA

The study was carried out between March 1999 and February 2001 at "Le Malandrine" estate, Central Italy (43°N, 11°E). The study area covers 465 ha, at an altitude of 150-250 m a.s.l., and is dominated by open fields (83.3%) and small forest patches, predominantly oak *Quercus cerris*. Mean minimum monthly temperature was always higher than 0°C, whereas mean maximum monthly temperature was always higher than 10°C. For a more detailed description of the study area see Cimino and Lovari (2003).

METHODS

Seven adult males (M) were caught by drive-netting and equipped with radiocollars (TXE-2 Televilt, 230 g; Biotrack, 200 g), transmitting on 150-151 MHz. Age-

class was estimated from antler development, tooth eruption and wear (Angibault *et al.*, 1993). Radio-collared animals were located by portable receivers (Custom Electronics CE-12; Wildlife Materials Inc. TRX-1000S) and a hand-held 3-element directional Yagi antenna (Amlaner and Macdonald, 1980). Forty-eight fixes/month/individual were collected using standard triangulation techniques, with a minimum interval of two hours between consecutives fixes, to provide biologically independent locations (Kenward, 1987). Fixes were collected in 6-hour blocks (06:00 am-12:00 am; 12:00 am-06:00 pm; 06:00 pm-12:00 pm; 0:00 am-06:00 am), to provide data for the whole 24-hour period within each week, to reduce the effects of daily autocorrelation (Harris *et al.*, 1990). Animal locations were represented on a grid map of the study area (scale: 1:5000). Location accuracy was preliminarily tested in the field. The mean locational error was smaller than 25 m and a grid size of 50 m x 50 m was adopted. Between March 1999 and February 2001, 7176 locations were collected. Radiotracking data were inserted in a database and analysed using the software Movement for Arcview (Hooge and Eichenlaub, 1997) to calculate home ranges (95% kernel) and core areas (50% kernel).
Months were classified as warm (May-October, mean maximum temperature ≥ 20° C) and cold (November-April, mean maximum temperature ≤ 20° C) seasons.

RESULTS AND DISCUSSION

The median annual site fidelity of males, estimated as percentage overlap of the home ranges of each male in the ruts 1999 and 2000, was 62.9% (interquartile range=47.5-79.2%). The distances between the centre of each core area (50% kernel) in the warm season (May-Oct 2000) and the centre of the core area of the same male in each bimonthly period were measured to provide an estimate of the site fidelity of males throughout the year (Fig. 1). Since males are territorial in the warm season, the core area of each male in the warm season has been taken as a reference (centre of the web in Fig 1). Core area centres tended to remain constant from one bimonthly period to the next (within a range of 50 m) in the warm (i.e. reproductive) season compared to the cold season.
The site fidelity of male roe deer was high. M2 and M3 even maintained the same core areas during the warm and cold months: being resident throughout the year could privilege territory holders, already present at the beginning of the territorial season in respect to late-coming males (e.g. Maynard Smith, 1974; Liberg *et al.*, 1998; Hardenberg *et al.*, 2000). Therefore, two strategies of males may be identified: “annually site-faithful” males, occupying the same home range throughout the year and “seasonally site-faithful” males, moving to another area in the cold season. This is consistent with the view of the “always stay” territorial behaviour (as a “low risk-low gain” strategy maximizing high survival and long tenure, Linnell and Andersen, 1998, also in a warm climate and food rich area).

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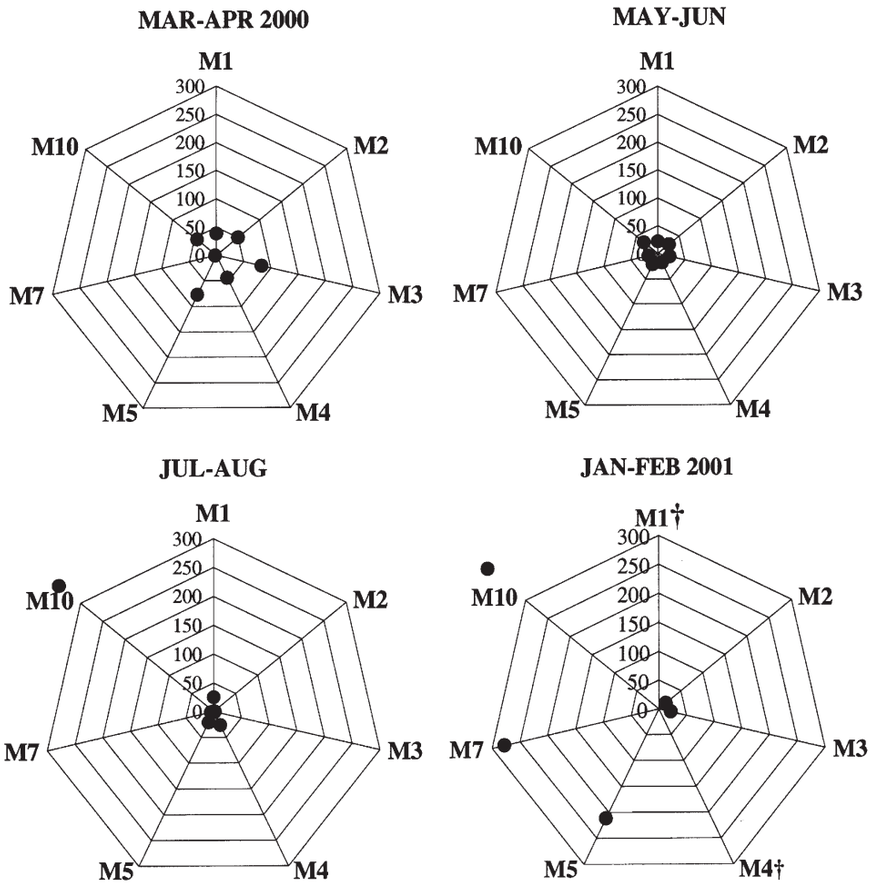

Figure 1 - Distances (metres) between the centre of each bimonthly core area, 50% kernel, in the warm season (May-Oct 2000), of each male (centre of the heptagon) and the centre of the core area of the same male in two-month periods. The distance provides a measure of site fidelity for each male, assuming that the core area in the warm season, when males are territorial, is the most stable one. † dead; M: radiotagged male.

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