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HOME RANGE AND HABITAT USE OF ROE DEER *(CAPREOLUS CAPREOLUS)* REARED IN CAPTIVITY AND RELEASED IN THE WILD

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ABSTRACT - In autumn 1992 two subadult males, reared in captivity, were radio-tagged and released on the northern slopes of Monte Carso near the city of Trieste.

The annual mean sire of the home range resulted to be 38.5 ha by the Outer Polygon method and 66.4 ha by the Harmonic Mean method. The mean size of the home range was found to be smaller. with both methods. in the hicrchical-territorial period (13.5 and 7.3 ha respectively) and larger in the indifferent period (22.5 and 24.5 ha respectively). We found the same trend for the overlap between the home ranges (25.5% in the yearly period, 1.5% in the hierarchical-territorial period and 16.8% in the indifferent one). The animals avoided open vegetation areas (meadows and pastures) and the urbanized zones. Them showed a slight preference for woods and used areas between urbanized zones depending on their availability.

Key words: Capreolus capreolus, Captivity, Home range, Habitat use.

INTRODUCTION

In this study we analysed the home range and the habitat use of roe deer (*Capreolus capreolus*) reared in captivity and released in the wild. The aim was to analyse their chances of adaptation and to compare the behaviour of these subjects with that of the species in it5 natural state.

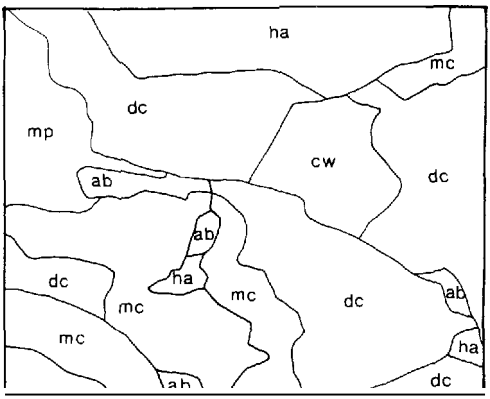
STUDY AKEA

We chose an area of 400 ha around the point where the animals were rcleased. This area is situated on the northern slopes of Monte Carso near the city of Trieste. between the Rosandra Stream and the border with Slovenia. It includes two settlements and a urhanired arca connected by harbour-traffic. Altitudes vary between sea-level and 270 metres. The geology is mainly composed of marneous-arenaceous lithotypes and the vegetation mainly consists of deciduous coppice (Ostryo-Quercetum). There are also some small and mixed plots of cereals, fodder crops and vegetable-gardens (Table 1, Fig. 1).

A natural population is established in this habitat. Its density was determined by drive censuses in spring and resulted to be 20.2 ind/100 ha. The population was found to have a sex ratio (males-

Table 1 - Habitat composition of the study area.

	Area (ha)	%
Deciduous coppice	181.3	45.3
Coniferous woods	19.2	4.8
Meadows and pastures	*50.3*	12.6
Mixed crops	84.2	21.1
Urbanized areas	53.9	13.5
Areas between urbanised areas	11.1	2.8



dc = deciduous coppice
cw = coniferous woods
mp = meadows and pastures
mc = mixed crops
ha = urbanised areas
ab = areas between urban areas

Fig.1 Habitat pattcm of the study area

females) of 1:1.4 in adults and 1:1 in the young. The young-subadults-adults ratio was found to be 1:0.25:1.87 (Pandini and Cesaris 1992).

Material and Methods

Wc radio-tagged two, 17-months-old, subadult males (1 and 2) and released them in the wild in November 1992. We used two transmitters with frequencies of 173.256 and 173.266 MHz. They had a movement and mortality feeler, 24 months duration and an emission range of 5-9 km. Thcy were fastened to collars which were made of degradable polymer fibres and had a formulated breaking effect which began after 35 months. We used two receivers with 150 dBm sensitivity (to pick up the signals). Thcy were fed by 12 Volt batteries and had directional antennas with 75-80 Ohm impedance and a 15 dB VSWR 1.5:1 gain. We carried out home-range analyses by using the Outer Polygon and Harmonic Mean methods (Kenward 1987, Harris et al. 1990) utilizing the package "Range IV. Software for Analysing Animal Location Data" (Kcnward 1990), by using 100% of fixes recorded.

For the interpretation of results the whole study period (from November 1992 to September 1993) was considered as an annual period and the following two periods relating to the annual biological cycle of the species (Kurt 1970) were considered:

indifferent period from 1/9/92 to 31/1/93
hierchical-territorial period from 1/2/93 to 31/8/93.

We determincd the home-range overlap as being the percentage ratio between the area of overlap of the two home-rangcs (determined by the Outer Polygons method) and the total areas of the home-rangcs.

Table 2 - Home range size (and number of fixes) in the different biological periods. Outer Polygon method.

	Male 1		Male 2		Mean	S.D.
Annual homc range	30.5	(33)	46.6	(76)	38.5	8.0
Indifferent period	8.5	(17)	36.6	(20)	22.5	14.0
Hierarchical-territorial period	20.7	(16)	6.3	(43)	13.5	10.2

Table 3 - Home range size (and number of fixes) in the different biological periods. Harmonic Mean method.

	Malc 1		Male 2		Mean	S.D.
Annual home range	46.9	(33)	86.0	(76)	66.4	19.5
Indifferent period	18.0	(17)	31.0	(20)	24.5	6.5
Hierarchical-territorial period	8.2	(16)	6.5	(43)	7.3	0.8

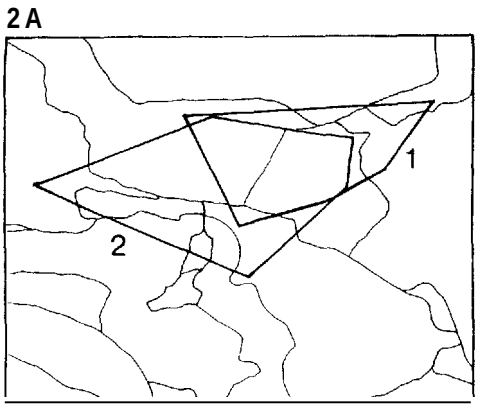
We determined habitat preferences by the chi-square test between use (i.e. observed frequencies of fixes recorded in every kind of habitat) and availability (i.e. expected frequencies relating to habitat composition of the study area). We calculated Bonferroni simultaneous confidence intervals for significance values of chi-square.
For statistical analyses we used the One-Way ANOVA to compare mean values and the chi-square test to compare frequencies.

RESULTS

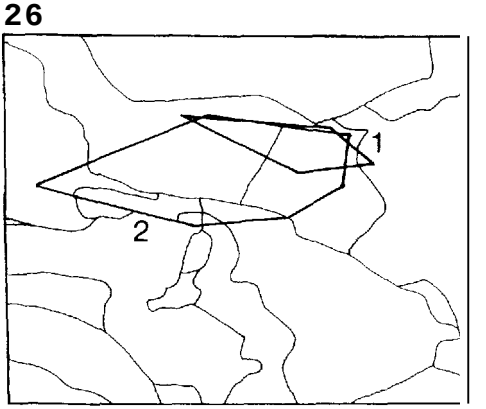
We found no significant differences in the mean size of the home-range between the methods we used (Table 2 and Table 3) for the whole period of study (F=1.75, n=2, P=0.317), for the indifferent period (F=0.01, n=2, P=0.911) and for the hierarchical-territorial period (F=0.72. n=2, P=0.485).
We found no significant differences in mean size of the home-range between the two individuals in any period (F=1.66, n=2, P=0.327 for the annual period; F=18.89, n=2. P=0.065 for the indifferent period; F=1.66, n=2, P=0.327 for the hierarchical-territorial period).
The comparison between the different biological periods (Table 2 and Table 3) showed no significant differences in the mean size of the home range calculated by the Outer Polygon method (F=1.54, n=3, p=0.347) but differences in borderline significance were found in the mean size of the home range calculated by the Harmonic Mean method (F=6.52 n=3, P=0.07). In the latter case the mean size of the home range of the the hierarchical-territorial period was significantly smaller than the home-range size of the indifferent period (Duncan Multiple Range Test).
Considering the whole year, the home ranges were found to overlap by *25.5%*. We found significant differences in the overlap of home-ranges between the different biological periods (chi-square=128.71, d.f.=2, P=0.000) with smaller values in the hierchical-territorial period (1.5%) than in the indifferent period (16.8%). Practically, in the hierarchical-territorial period the home-ranges were found to be separate (Fig.2 and Fig.3).
With regard to habitat use (Table 4), we found significant differences between expected and observed frequencies in the annual period and in the other biological periods (respectively chi-square=73.13, d.f.=5, P=0.000; chi-square=86.93, d.f.=5,

Table 4 - Habitat preferences of roe deer in the different biological periods. Bonferroni simultaneous confidence intervals. * = significant differences between observed frequencies and expected frequencies

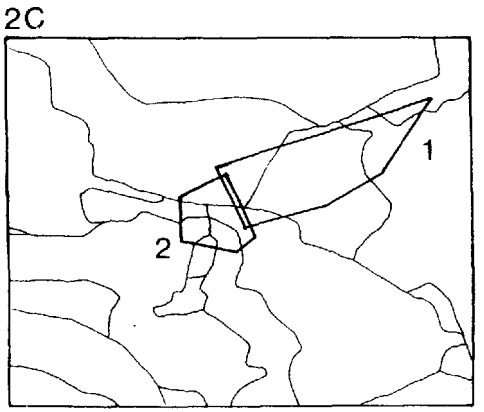
	BIOLOGICAL PERIODS		
	annual (n=109)	indifferent (n=50)	hierar.-territorial (n=59)
Deciduous coppice	0.368	0.280 *	0.423
Coniferous woods	0.284 *	0.440 *	0.153
Meadows and pastures	0.037 *	0.080 *	0.000 *
Mixed crops	0.280	0.200	0.039 *
Urbanized areas	0.000 *	0.000 *	0.000 *
Areas between urban arras	0.027	0.000 *	0.034
Chi-square	13.12	86.93	37.06
P	0.000	0.0000	0.0000



2.A = annual period



2.B = indifferent period



2.C = hierarchical-territorial period

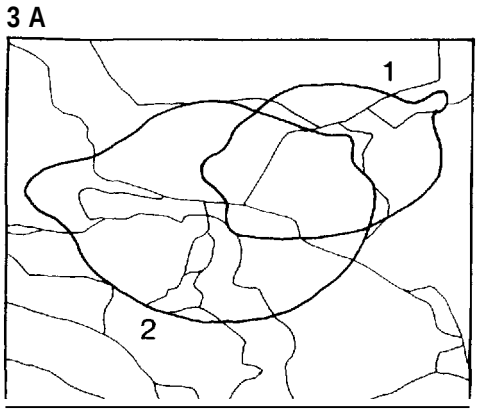
Figure 2 - Home ranges of the roe deers using the Outer Polygon method

P=0.000; chi-square=37.96, g.l.=5, P=0.000). The deciduous coppice was avoided in the indifferent period and used according to its availability in the other periods. The coniferous woods were selected in the indifferent period and in the annual study period and used according to their availability in the hierarchical-territorial period. Meadows were avoided in all the period; mixed crops were preferred in the hierarchical-territorial period and used in accordance to their availability in all other periods. Areas between urbanised areas were used according to their availability in the annual period and in the hierarchical-territorial one, but avoided in the indifferent period. period. The urbanised areas were avoided in all the biological periods.

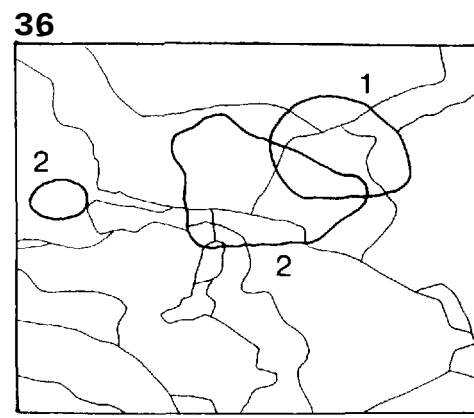
Discussion

The mean size of the annual home-range we found is similar to that found in other radio-tracking studies which used captured subjects. Jeppesen (1990) found home ranges from 16 to 8t ha. with a mean value of 42 ha (n=24), by the Outer Polygon method.

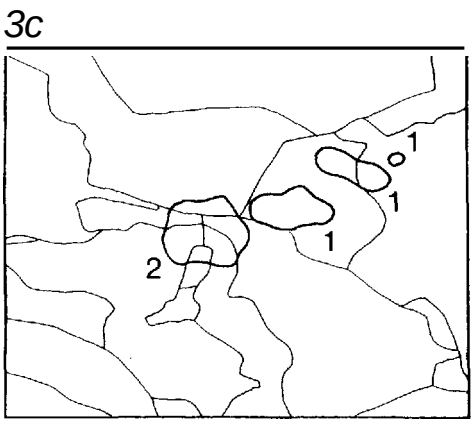
The decrease in the home-range size we observed during the course of the year is probably owed to competition among males. This reflects a natural trend of the biology **of** this species as has already been described in previous studies. In France Maublanc (1986) found that autumn and winter home ranges (i.e. the indifferent period according to the criteria adopted in this work) were significantly wider than spring and summer home ranges (i.e. the hierarchical-territorial period). though the ranges he reports were



3.A = annual period



3.B = indiffcrent period.



3.C =hierarchical-territorial period

Figurc 3 - Home ranges of the roe deers using Harmonic Mean method

larger (105 ha in autumn, 104 in winter. 68 in spring and 56 in summer). Cases of a wider home range in spring and autumn have also been reported in literature (Sempéré et al. 1986) but. according to authors' conclusions, these results refer to males which are unable to establish a territorial area during the breeding season. It was also evidenced in this study that their home ranges overlapped minimally during the hierarchical period. However, during the remaining part of the year, they clearly overlapped.

The territoriality attained and the home range sizes were similar to those found in natural populations, which suggests that the subjects we studied adapted fairly well in the wild.

Habitat use also reflects typical behaviour of this species with preference for woodlands and avoidance of open spaces (i.e. meadows and pastures). The avoidance of urbanized areas and of the areas between them shows a fairly good degree of wildness achieved by the animals apart from a moderate feeding dependence on human environments, which can be deduced from the preference shown for mixed plots of cereals, fodder crops and vegetable-gardens located ncar settlements. This habit, however; is also quite used by natural populations.

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