

Food Availability as a Factor in Habitat Use by Roe Deer

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The influence of forest structure (food and cover availabilities) on habitat use by roe deer *Capreolus capreolus* (Linnaeus, 1758) was studied comparing home ranges in a shrubowood (much food, low visibility between deer) and a coppice (low food, good visibility). There was no change in home range location during the year. Home ranges were greater in the shrubowood than in coppice and showed greater seasonal variations. Population density was higher in shrubowood. Roe deer showed a different strategy in an area with good trophic availabilities but crowded and in an area with poor trophic availabilities but less crowded.

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1. INTRODUCTION

Habitat use and social structure in ungulates can be related to the combination of several parameters including food availability and distribution, cover availability and distribution, population density (Crook *et al.* 1976). Many studies have been conducted, showing a flexibility of social systems in ungulates related to environmental conditions (Leuthold, 1970; Walther, 1972; Peek *et al.*, 1974; Franklin *et al.*, 1975; Leuthold & Leuthold, 1975; Hirth, 1977; Georgii, 1980; Schaal, 1982, 1987; Underwood, 1982; Maublanc *et al.*, 1987). Roe deer are widely distributed, from northern Europe to the Mediterranean Sea and populations occur in very varied habitats: coniferous and deciduous forests, open fields. Home range and social structure of roe deer have been studied in forest (Standgaard, 1972; Sempéré, 1979 a, b, c; Bideau *et al.*, 1983 a, b, c, 1985), and in agricultural landscape (Bresiński, 1982; Stüwe & Hendrichs, 1984; Maublanc *et al.*, 1985, 1987; Zejda, 1985). In all habitats, roe deer social structure shows a seasonal variation. In spring and summer, it is an individualist type (territorial behaviour in males) and an associative one in autumn and winter. Differences in social behaviour and home ranges were observed in different habitats: under forest conditions, roe deer lead family way of life (male, female and young) keep-

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ing in small groups (Bideau *et al.*, 1985) whereas in open fields, roe deer become gregarious (Bresiński, 1982; Stüwe & Hendirchs, 1984; Maublanc *et al.*, 1985, 1987); their home ranges are greater in open fields than in forest habitats (Kałusiński, 1974, 1982; Zejda, 1985; Maublanc, 1986). Studies on the diet have shown that it is selective in forest habitats; it is based on twigs and grasses and depends on the availabilities and chemical composition. (Siuda *et al.*, 1969; Bobek *et al.*, 1972; Borowski & Kossak, 1975; Szmidt, 1975; Goffin & Combrugghe, 1976; Kossak, 1976; Cannac, 1978; Henry, 1978; Perzanowski, 1978; Drożdż, 1979; Cederlund *et al.*, 1980; Jackson, 1980; Helle, 1980; Hosey, 1981; Maizeret & Tran Manh Sung, 1984).

The purpose of this work was to determine the influence of forest structure (*i.e.* food availability and cover) on habitat use by roe deer. A comparative approach was used: home ranges were studied in two adjacent areas with different phytostructural characters within a fenced forest:

— a shrubwood, characterized by abundant bushy vegetation with a thick grass carpet and many tree shoots (much food, no visibility between animals);

— a coppice characterized by very low ground vegetation and no tree shoots (little food, good visibility).

2. STUDY AREA

The work was carried out in the Chizé forest, located in the middle of western France (46°10'N and 0°27'W) near the Atlantic coast. The Government controlled forest is 5000 ha, 2620 of which are entirely fenced since 1952 and constitute a reserve for roe deer. Climatic conditions are those of a temperate oceanic climate. The forest, which lies on calcareous soils is in the European temperate biome. The major tree species are oak (*Quercus sp.*), beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*), maple (*Acer campestre*, *A. monspessulanum*) cornel tree (*Cornus mas*, *C. sanguinea*) and hawthorn (*Crataegus monogyna*, *C. oxyacantha*).

The study area was divided into two parts on account of the forest structure (Sempéré & Mauget, 1979) (Fig. 1):

— The shrubwood (300 ha): this structure is the result of tree felling five years ago, characterized by bushy and herbaceous vegetation (stage F1 described by Sempéré & Mauget, 1979). Two neighbouring areas were sampled: S1 which is structurally homogenous, and S2, an heterogenous area, with bands of shrubwood 150 m wide separated by bands of coppice 150 m wide.

— The coppice (400 ha): characterized by a dense foliage layer and virtual disappearance of bushy vegetation and grass. This portion of the study area was not affected by forestry activities in the past thirty years. In this structure, the vegetation was sampled in three areas (C1, C2, C3). They belong to the stage T3 described by Sempéré and Mauget (1979).

These areas are near a cultivated field of 15 ha with equal proportion of italian rye grass, lucerne and clover mixed.

The mean population density of roe deer (results from Office National de la Chasse) in the closed reserve was evaluated with kilometric abundance index (Vincent, 1982). It was about 14.3/100 ha and increased to 21.5/100 ha in the five years before the beginning of the study. In the study area, there were local differences in deer density: about 20/100 ha in coppice and 40/100 ha in shrubwood. The population size was regulated by annual captures: deer equivalent in number to the number of kids surviving to 6 months of age were removed from the area. This number was evaluated by counting animals in March (before births) and October (Kilometric abundance index).

3. MATERIAL AND METHODS

3.1. Radio-Tracking

The study on habitat use was conducted using portable radiotracking equipment (ATNE transmitters, ATNE RT80 receivers and Yagi antennas). Deer were simultaneously located by two observers: one at a fixed post (mirador) at the

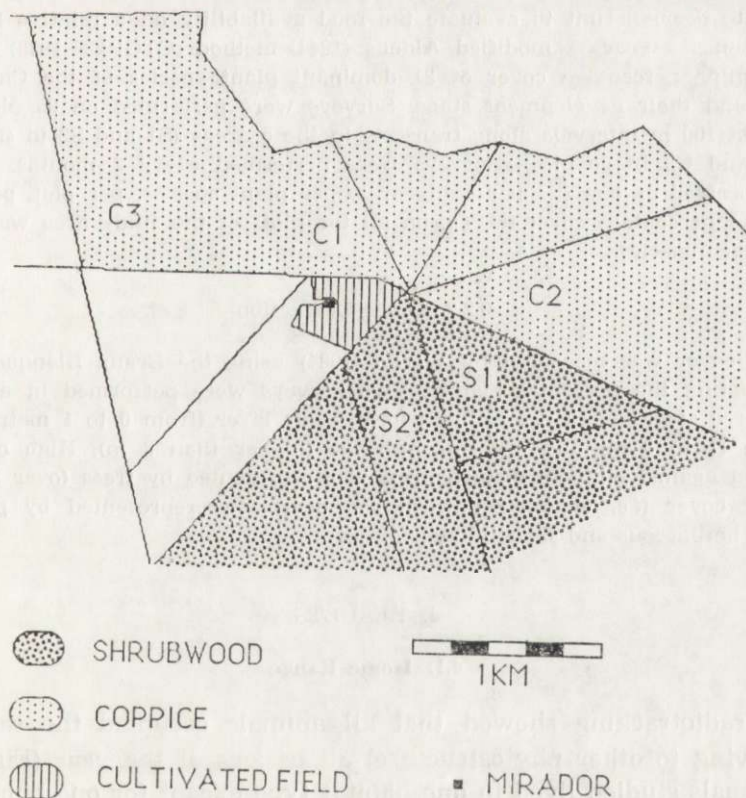


Fig. 1. Study area (C1, C2 and C3: sampling areas in Coppice. S1 and S2: sampling areas in Shrubwood).

centre of the study area, and the other in a vehicle permitting a good triangulation (Springer, 1979). The precision of the system was tested using transmitters disposed in points of the study area which could be mapped. The transmitters were located 15 times with an error between 2 to 24°. The most frequently error done by experimented users ($\pm 5^\circ$ error, *i.e.* about 100 m maximum for the forest locations). To calculate home range size, we used the method of convex polygon.

Seven animals (3 males and 4 females), each over 3 years old, were radio-collared and followed for an annual cycle. Every week, the deer were located every 20 minutes during two periods (one at night and one during the day) of four hour each. These periods were altered so that in three weeks a complete 24 hours cycle was completed. In addition, the deer were located every 20 minutes for a whole day every 1.5 months. The home range size was measured for 2 months (*i.e.* about 100 locations per animal, except once (August-September) 60 locations).

3.2. Vegetation Study

3.2.1. Food Availability Survey

The measure of percentage cover of plants up to 1.5 m from the ground (accessible to deer) permit to evaluate the food availability on a relative large area several times a year. A modified Aldous (1944) method (CTGREF 1978) was used to determine percentage cover of 21 dominant plant species of the Chizé forest (Fig. 4) and their development stage. Surveys were performed on 95 plots (40 m 2 each) at 100 m intervals along transects in the 5 areas (S1 and S2 in shrubwood, C1, C2 and C3 in coppice). Surveys were performed every 2 months. The data were processed as one file per study area, per plant species, per plot, per survey. The mean percentage cover (MPC), on all the plots of the study area was calculated for each species.

3.2.2. Cover Evaluation

Plant cover was measured by Werno (1984) using the Braun Blanquet method by evaluating the percentage cover. Two surveys were performed in each study area. Three stages were determined: herbaceous layer (from 0 to 1 metre), shrubby stage (1 to 3 m) and arborescent stage (higher than 3 m). High cover (*i.e.* protection against climatic disturbances) was represented by trees (over 3 m high) and low cover (*i.e.* visibility between roe deer) was represented by percentage cover of herbaceous and shrubby stage.

4. RESULTS

4.1. Home Range

The radiotracking showed that all animals occupied the same area (no moving to other phytostructure) all periods of the year (Fig. 2). All the animals studied lived in one habitat type except for one buck (n° 63) whose home range included both shrubwood (S1) and coppice (C2). Mean home range size (Fig. 3) was greater in shrubwood than in cop-

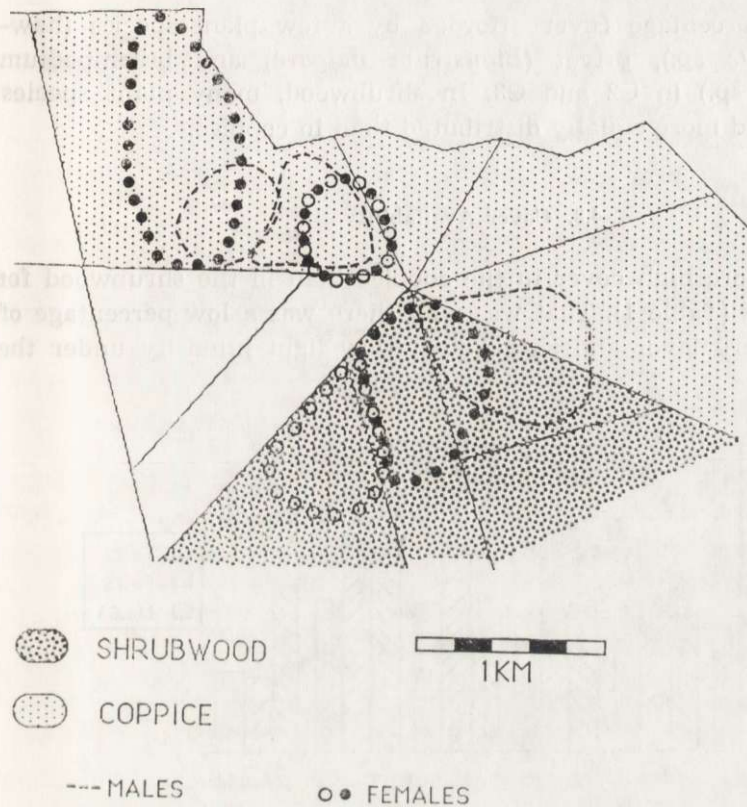


Fig. 2. Annual home range location determined by radiotracking.

pice, except for one doe (n^o77). There was more variation in home range size in shrubwood (40 to 120 ha) than in coppice (except n^o77).

For female n^o24 and male n^o23 in coppice, home range was slightly greater during the period when foliage was not developed (from October to end of March) than in summer. This phenomenon was observed for others animals, even in the same phytostructure.

4.2. Food Availability Study

Evaluation of food available showed great differences between the habitats: the mean percentage cover (MPC) for species in the shrubwood (S1 and S2) was about 3 times bigger than in the coppice (C1, C2 and C3) (Fig. 4). Inside the same stage differences could be observed: MPC was maximum in C1 and minimum in C3. The coppice was characterized

by the large percentage cover afforded by a few plant species (hawthorn (*Crataegus* sp.), privet (*Ligustrum vulgare*) and brachipodium (*Brachypodium* sp.) in C2 and C3. In shrubwood, many plant species were present and more equally distributed than in coppice.

4.3. Cover Availability

There was more high cover in the coppice than in the shrubwood for the two surveys (Table 1). That was why there was a low percentage of cover in the herb layer and shrub layer (low light intensity under the

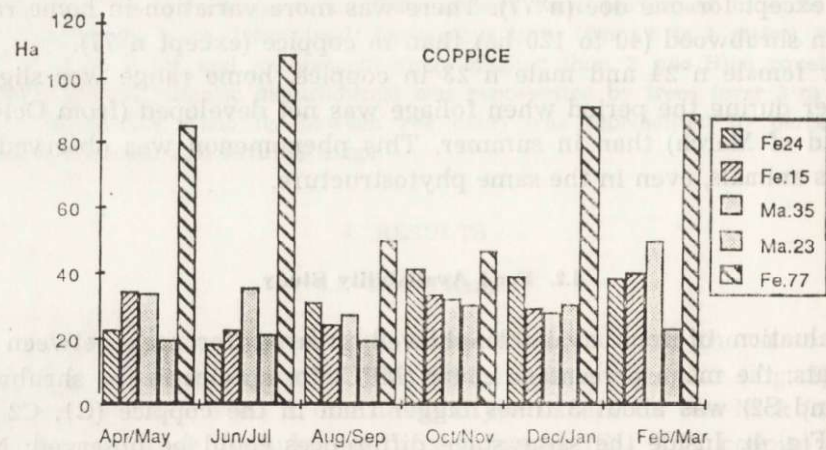
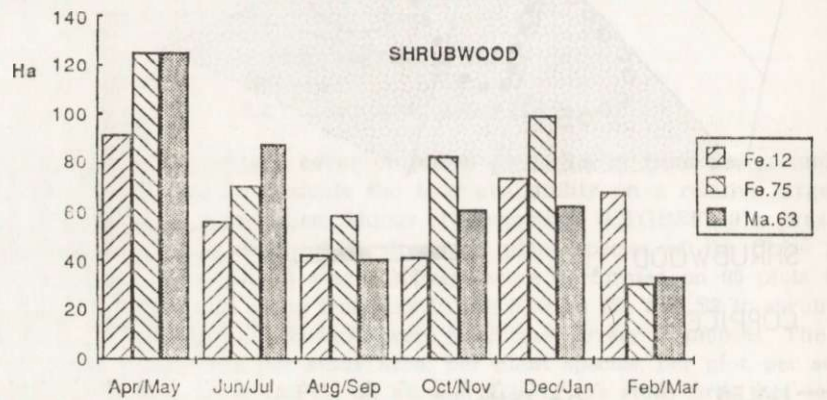


Fig. 3. Bimonthly home range size (ha) of roe deer in shrubwood and in coppice.

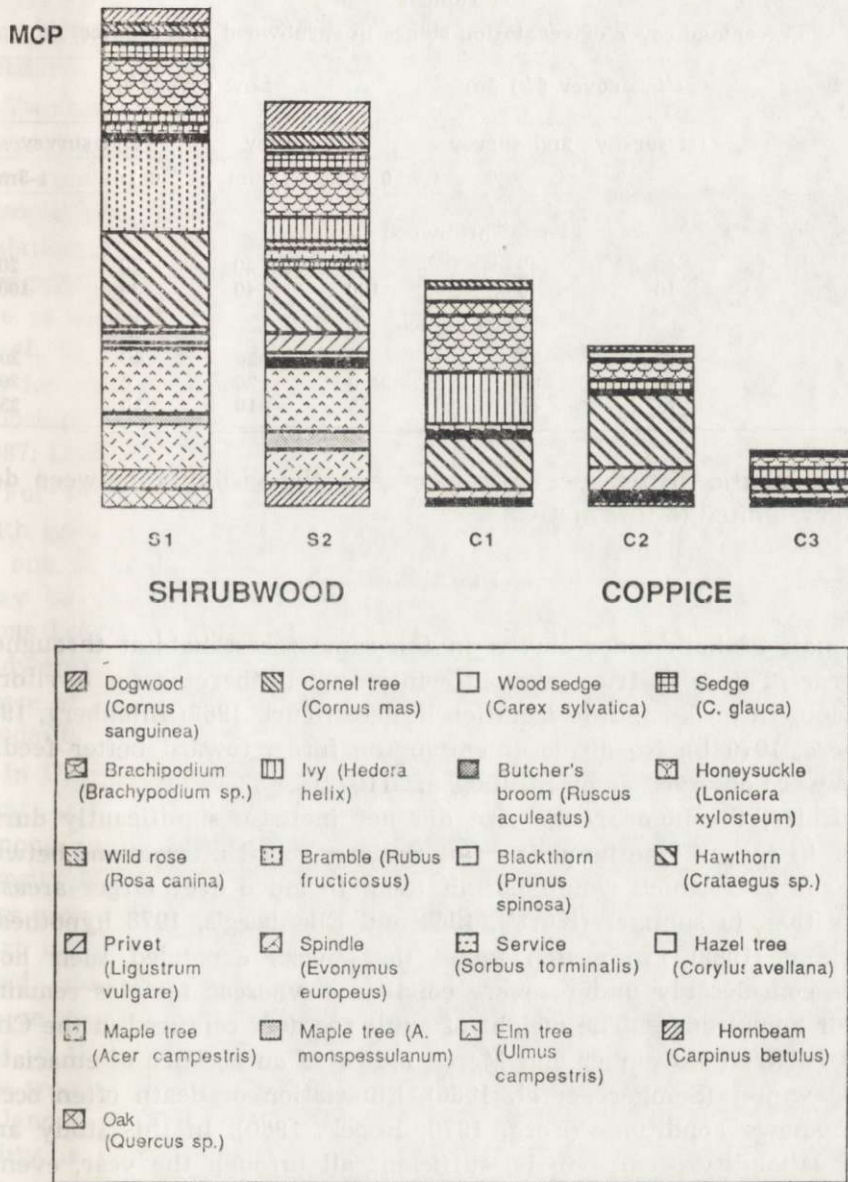


Fig. 4. Mean percentage cover (MPC) of the plant species recorded in shrubwood (S1 and S2) and coppice (C1, C2 and C3).

trees). So, in the coppice, the visual communication between animals was easy. Low cover was very abundant in the shrubwood: the protection

Table 1
Percentage cover of vegetation stages in shrubwood and coppice.

Study area	High cover (%/o) 3m		Low cover(%/o)			
	1st survey	2nd survey	1st survey		2nd survey	
			0-1m	1-3m	0-1m	1-3m
Shrubwood						
S1	25	45	80	30	70	20
S2	10	0	100	40	30	100
Coppice						
C1	75	75	0	20	40	20
C2	80	80	0	20	0	20
C3	75	45	15	10	10	25

against climatic disturbances was poor and the visibility between deer was very limited (a few metres).

5. DISCUSSION

Animals of both sexes stayed in the same forest habitat throughout the year. This was true even in winter when there is no territorial behaviour in bucks and no lactation in does (Kurt, 1968; Ellenberg, 1978; Sempéré, 1979 b). No displacement in the forest toward better feeding places were observed as by Strandgaard (1972).

In Chizé, the home range size did not increase significantly during winter in spite of the breakdown of summer social interactions between adult roe deer which would permit them to move over larger areas in winter than in summer (Kurt's, 1968 and Ellenberg's, 1978 hypothesis). Cederlund (1982) in Sweden found that bucks expanded their home ranges considerably under severe conditions whereas females remained in their home ranges. The weight of adult roe deer captured in the Chizé forest between November and March indicated an absence of emaciation during winter (Sempéré *et al.* 1986). Emaciation or death often occurs under snowy conditions (Borg, 1970; Bobek, 1980). In this study area, food availability seemed to be sufficient all through the year, even in the poorest part of the coppice (C3). The Chizé forest is fenced so emigration is not possible. But, on a relatively small area (2620 ha), the deer can find several types of forest habitats with various food and cover availabilities. The animals establish their home range in the forest in terms of some constraints and preferences. It depends on the availability of preferred and less preferred habitats in relation to population density (Partridge, 1978). An important constraint is the intraspecific competition

in roe deer. Competition for space, from March to September, leads to territorial behaviour of bucks directed to the eviction of the other competitors.

Two situations can be observed: (1) in a case of low population density, there is enough place for all the deer. So, the territorial behaviour caused the other males to be evicted (Bideau *et al.* 1983 a). There are no associations between them but space sharing. (2) In a case of high population density (*i.e.* resources per animal are lower), the animals either emigrate or stay (note that some natural barriers against emigration are as efficient as fences). Several males use the same range (Vincent *et al.*, in prep). In this case, and in patchy resources habitats (agrocenosis for example), competition for resources is greater: dominance relationships and a hierarchy among males are observed (Maublanc *et al.*, 1987; Diot, 1988).

For what reasons are some areas preferred? (1) in one hand, an area with good trophic and cover availabilities is more attractive than another one. (2) in the other hand, the criteria for the choice of a home range may be dependent on an individual life story. In ungulates, correlations between mother's and kids' diets have been shown several times (Edwards, 1976; Leclerc & Lecrivain, 1979; Leuthold, 1977). The inheritance of food habits make it possible to understand the trophic harvest modality (Gautier, 1982).

In Chizé forest, two situations were observed: (1) an area with abundant and diversified food availability but where visual information among animals is limited owing to dense foliage. This area is attractive: density is high. Space competition is certainly more important than in less crowded places. Home ranges reach a great size. Keeping in mind that many animals live in these places, and that extended areas are used, one can think that several animals make use of the same area. So relationship of dominance (as observed on the cultivated field located in the very middle of the study area (Diot, 1988) is obvious as in the woods. Space utilization would be determined by mean of "strength balance" among neighbouring animals. (2) An area where food availability is poor but where long distance visual information is possible. Its attractiveness is poor (low density). Home ranges are small sized in comparison with shrubwood. Owing to the number of animals staying in that place and to what is known about territorial behaviour (aggressiveness), one can suppose that there is space sharing with only slight overlapping of home ranges at the periphery.

So, the first situation (shrub) is a good one in regard to feeding but socially stressing although the thickness of cover make it easier to in-

habit the same place. The second area (coppice) is more satisfactory regarding to social situation, but not so interesting for feeding. Kluyver and Tinbergen (1953) observed some related situation in Tit mice, where habitat selection was determined by two opposite tendencies: preference for certain kind of favourable habitats (feeding, cover) and shyness for too crowded habitats.

So, we observed that in places relatively near to one another (2 km), individuals belonging to the same population display different strategies of space utilization, according to the kind of biotope in which they live. The factors which determine the choice of the home range are still unknown.

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DOŚPIĘPNOŚĆ POKARMU JAKO CZYNNIK MODYFIKUJĄCY UŻYTKOWANIE
ŚRODOWISKA PRZEZ SARNY

Streszczenie

Badano wpływ struktury lasu (dostępność pokarmu i widoczność) na użytkowanie środowiska przez sarny. Porównywano arealy sarn w zakrzaczeniach (obfite zasoby pokarmu, mała widoczność) i w młodnikach (ubogie zasoby pokarmu, dobra widoczność) (Tabela 1, Ryc. 1). Arealy sarn były mało zmienne w ciągu roku (Ryc. 2). Arealy obejmujące zakrzaczenia były większe i bardziej zmienne sezonowo niż arealy w młodnikach (Ryc. 3). Zagęszczenie populacji sarn było jednak wyższe w zakrzaczeniach.