

DIET COMPOSITION OF ROE DEER (*CAPREOLUS CAPREOLUS*) IN THE NATURAL PARK OF THE GARROTXA VOLCANIC ZONE (CATALONIA, SPAIN)

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ABSTRACT.— The present work outlines the results of a study on the food consumed by roe deer carried out in the Natural Park of the Garrotxa Volcanic Zone, where 49 roe deer were reintroduced from 1995 to 1998. This is a protected area of about 12,000 ha, in which oak and beech forests predominate. Faecal analysis was chosen as the most appropriate method for sampling diet composition despite the scarcity of faecal samples encountered from 1998 to 2001 (n=30). A total of 7,500 epidermal fragments were identified from these samples. Results showed that ivy (*Hedera helix*) and bramble (*Rubus sp.*) formed the bulk of the diet (23% and 21%, respectively). Woody species also formed an important part, reaching 33% of total fragments. Herbs and grasses were only notable in the spring-summer period. Some major vegetation components such as beech (*Fagus sylvatica*) were rarely consumed by deer.

RÉSUMÉ.— Voici le résultat d'une étude sur l'alimentation du chevreuil dans le Parc Naturel de la Zone Volcanique de la Garrotxa, où 49 individus furent introduits entre 1995 et 1998. Il s'agit d'un espace protégé de 12 000 ha environ, dominé par les forêts de chênes et de hêtres. Malgré le nombre très bas d'excréments rencontrés entre 1998 et 2001 (n=30), leur analyse nous a paru la meilleure méthode pour tester la composition de l'alimentation. À partir de ces échantillons, nous avons identifié 7 500 fragments d'épiderme. Les résultats nous montrent que le lierre (*Hedera helix*) et la ronce (*Rubus sp.*) sont l'alimentation principale (23 et 21% respectivement). Toutefois, les espèces ligneuses sont également à considérer, puisqu'elles forment 33% des fragments totaux. Les herbes et les graminées s'avèrent importantes au cours du printemps-été. Il est à noter que les principaux composants de la végétation tel le hêtre (*Fagus sylvatica*) étaient très rarement consommés.

RESUMEN.— Se exponen los resultados de un estudio de la alimentación del corzo llevado a cabo en el Parque Natural de la Zona Volcánica de la Garrotxa, donde 49 corzos fueron reintroducidos desde 1995 hasta 1998. Este área protegida comprende unas 12.000 ha con predominio de bosques de roble y haya. El análisis de heces fue considerado como el método más apropiado para determinar la composición de la dieta, a pesar de la escasez de muestras fecales halladas desde 1998 a 2001 (n=30). A partir de dichas muestras fueron identificados un total de 7.500 fragmentos epidérmicos. Los resultados muestran que la hiedra (*Hedera helix*) y la zarza (*Rubus sp.*) forman el grueso de la dieta (23% y 21%, respectivamente). Las especies leñosas forman también una parte importante, alcanzando el 33% del total de los fragmentos epidérmicos. Las herbáceas solo fueron importantes en el periodo primavera-verano. Algunos componentes mayoritarios de la vegetación, como el haya (*Fagus sylvatica*), fueron raramente consumidos.

Key-words: Microhistological analysis, faecal analysis, diet, ivy, bramble, oak, beech.

1. Introduction

Between 1995 and 1998, a total of 49 roe deer were reintroduced into the Natural Park of the Garrotxa Volcanic Zone (NPGV), in the NE of Spain. The monitoring plan of this population includes spatial distribution, demographic evolution, parasite control and diet selection (MINUARTIA, 1994; ROSELL, 2001). All of these parameters are difficult to estimate in forested areas (VINCENT *et al.*, 1991). Management of roe deer is controversial because farmers and foresters are concerned the roe deer's population effect on field crops and natural tree regeneration.

The aim of this work was the determination of the natural diet of roe deer in the NPGV.

2. Material and Methods

The study area comprises the whole of the Natural Park. A mosaic of forests dominates the landscape in this area: evergreen oak (*Quercus ilex*), other oak species (mainly *Quercus humilis*) and beech (*Fagus sylvatica*). Agricultural lands that cover the flat areas and common field crops grow alfalfa (*Medicago sativa*), rye grass (*Lolium multiflorum*) and corn (*Zea mays*).

Roe deer diets were estimated by determining the species composition of epidermal fragments in the faeces, in accordance with the procedures of the microhistological analysis employed by different authors (CROCKER, 1959; STEWART, 1967; GARCÍA-GONZÁLEZ, 1984; BARTOLOMÉ *et al.*, 1995).

The NPGV Guard Service collected faecal samples in the field between 1998 and 2001. Different pellet groups were considered as arising from diffe-

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rent individuals. Despite sampling being carried out once per month, only a total of 30 samples were collected during this period. Fortunately, samples ranged over the whole annual cycle.

Two-way indicator species analysis (TWINSPAN) applied to the sample-data set was employed in classifying diet types (HILL & GAUCHE, 1980).

3. Results and Discussion

A total of 7,500 epidermal fragments were identified in faecal samples and these were grouped in 56 different taxa. Figure 1 shows the mean annual diet for roe deer. The most important component in the diet were ivy (*Hedera helix*) and bramble (*Rubus sp.*) at 23% and 21% respectively, followed by woody species (mainly *Quercus* sp.), which account for 33%. Forbs represented 12%, and graminoids were the smallest fraction, at only 8%. These global results correspond with the finding of other authors who had studied the food preferences of roe deer in woodland areas (JACKSON, 1980; HOSEY, 1981; DEGREZ & LIBOIS, 1991; TIXIER *et al.*, 1997), even when other ungulate species are present (HEROLDOVA, 1996).

The main taxa and maximum values recorded in faecal samples are shown in Table 1. Ivy, bramble and evergreen oak were present in almost all samples. Ivy and bramble represented more than half of the diet in any sample, with evergreen oak at almost 40%.

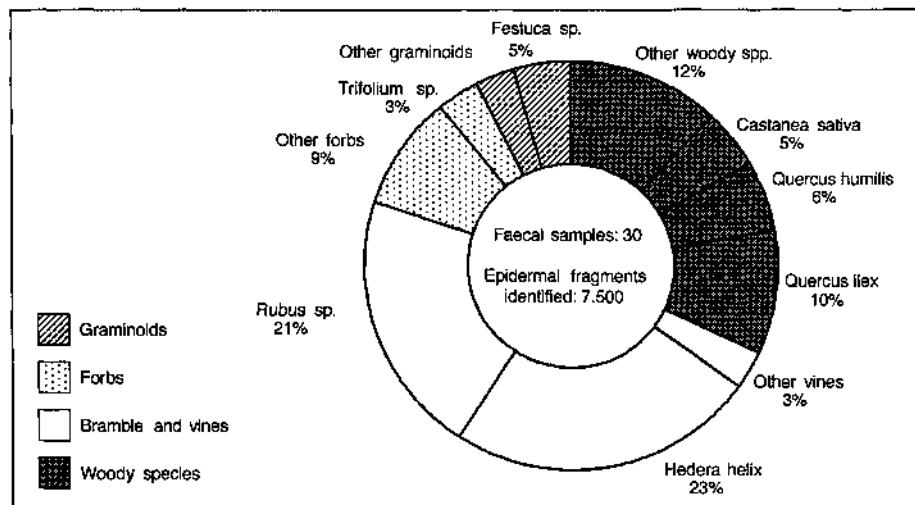


Figure 1. Mean annual diet of roe deer in the Natural Park of the Garrotxa Volcanic Zone.

Table 1. Main taxa recorded in fecal samples of roe deer (n=30) in the Natural Park of the Garrotxa Volcanic Zone.

	<i>Number of samples with the taxon</i>	<i>% maximum recorded</i>
Rubus sp.	30	53,6
Hedera helix	27	55,6
Quercus ilex	29	38,8
Quercus humilis	21	35,2
Citrus scorpius	23	33,2
Castanea sativa	14	28,4
Festuca sp.	13	30,8
Trifolium sp.	16	25,6
Pteridophyta	11	8,0
Verbascum sp.	6	47,6
Bryophyta	5	21,2
Medicago sativa (cultivated)	2	24,8
Lolium multiflorum (cultivated)	2	2,4
Zea mays (cultivated)	2	0,4
Buxus sempervirens	4	3,6
Total taxa=56		

Besides of ivy, some other toxic species were also well represented in the diet. Pteridophyta (probably *Pteridium aquilinum*) appeared in 11 samples; *Verbascum* sp. in 6, with this reaching 48% of the diet in one sample, and *Buxus sempervirens* in 4.

Cultivated species were highly occasional: they appeared in only 2 samples of each species. Alfalfa was the only cultivated species that represented an important percentage of the diet (25% in one sample).

Figure 2 shows the dendrogram obtained by TWINSPAN analysis of the samples. The first division (level 1) separated the more herbaceous diets (n=5) from the rest (n=25). A 'herbaceous diet' means a clear dominance of forbs and graminoids in the sample. All of these were collected in the spring-summer period. The second division (level 2) distinguished two other subgroups in the herbaceous group, one with highly herbaceous diets (n=3) and the other with mixed diets (n=2). A 'mixed diet' means a similar percentage of woody and herbaceous species.

On the other hand, level 2 grouped all the winter samples (n=11), which were dominated by woody diets. A 'woody diet' means a clearly higher percentage of woody species in the sample. The remaining samples (n=14) were divided at level 3 into two other groups. One of these grouped 3 mixed-diet samples collected in spring-summer period. The other group (n=11) included the remaining woody diet samples; at level 4, these were separated into a group of 6 samples collected in the autumn period, and another of 5 samples collected in the spring-summer period.

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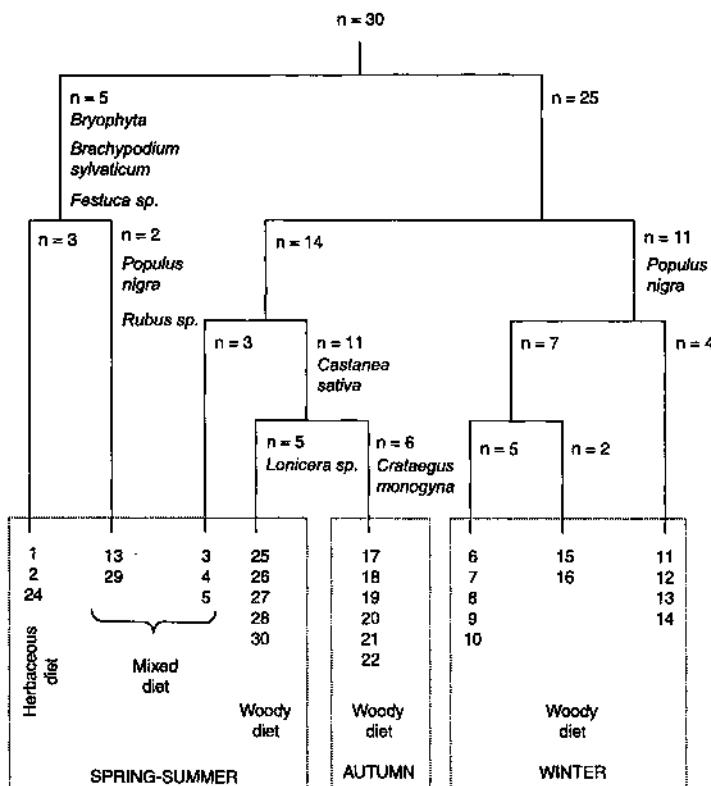


Figure 2. Results of the TWINSPLAN analysis expressed as a dendrogram showing hierarchical subdivisions of the samples x species data set to level 4. Indicator species are listed next to the branches.

To summarise, roe deer diets in the autumn and winter periods were dominated by woody species, and can be catalogued only as woody diets. However, in the spring and summer time, the proportion of woody and herbaceous species was highly variable between samples; the diets in this period can be defined as herbaceous, mixed or woody.

4. Conclusions

Ivy (*Hedera helix*) and bramble (*Rubus sp.*) formed the bulk of the annual roe deer diet (23% and 21%, respectively) in the Natural Park of the Garrotxa Volcanic Zone.

In the spring-summer period, it is possible to distinguish between a woody diet, a mixed diet or a herbaceous diet. Throughout the rest of the year, ligneous species were the major dietary components, and only a woody diet was obtained.

In this study, the roe deer diet corresponded to that of a concentrated selector ungulate, according to Hofmann (1989). Consequently, in addition to the more common species (bramble, ivy and oak), roe deer occasionally consumed certain other species, such as *Verbascum* sp., in high proportion.

According to these results, agricultural plants are consumed only occasionally and the main forest trees present in the area do not represent an important part in roe deer's diet. It is therefore suggested that consumption by this ungulate does not cause any significant problem to agricultural or forestry activities.

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