

Winter Plant Selection by Red and Roe Deer in a Forest Habitat in Hungary

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Matrai K. & Kabai P., 1989: Winter plant selection by red and roe deer in a forest habitat in Hungary. Acta theriol., 34, 15: 227—234 [With 1 Table & 2 Figs].

The winter diet of 20 red deer (*Cervus elaphus*) and 21 roe deer (*Capreolus capreolus*) occupying the same temperate forest habitat was investigated by histological analysis of rumen contents. The diet of red and roe deer consisted of 81 and 72% browse, respectively. Pine (*Pinus silvestris* and *P. nigra*) made up 27% of the diet for red deer and 35% for roe deer. Grasses and fruits comprised 17% in red deer diet while forbs and fruits comprised 25% of the roe deer diet. Kulczyński's similarity index showed a diet overlap of 28% between red and roe deer diets. Similarities were higher in pine than in other habitat types both among deer ($p < 0.001$) and between deer species ($p < 0.001$). Food choice of red deer was characteristic for intermediate feeders while that of roe deer was typical for concentrate selectors.

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1. INTRODUCTION

In the forest areas of Europe red and roe deer often occur together. It is important to establish if competition for food exists between the two species to insure proper wildlife management.

Hanley (1982) pointed to the importance of 4 physical characteristics in the food choice of herbivores. These are body size, type of digestive system (hindgut or ruminant), ratio of rumino-reticular volume to body weight and mouth size. Both red and roe deer are ruminants with different body and mouth size. Dressed weight of adult female red deer is about 5 times that of adult female roe deer in winter (75–85 kg, and 14–16 kg, respectively, Heltay *et al.*, unpubl. data). Rumino-reticular volumes to body weight of red and roe deer, however, are quite similar in winter (0.09–0.15, and 0.07–0.16, respectively, Heltay *et al.*, unpubl. data), Nagy & Regelin (1975) have shown that as the amount of particles high in cellulose content increased, the omasal tissue mass increased and the abomasal tissue decreased significantly in proportion to increasing body weight of roe, fallow and red deer. Red deer have larger body weight

and a relatively lower metabolic requirements/unit of body weight than roe deer. Consequently, roe deer need to economize on their efforts in searching for food. Therefore, red and roe deer very likely select different foods in different way from the same habitat.

The hypothesis that (1) the proportion of the main plant groups differs in red and roe deer diets and (2) the dominant plant species of the microhabitats set a higher value on roe than red deer are tested in this study.

2. STUDY AREA

The study was conducted in a 3,500 ha forested area near Budapest (47° 28'N, 19° 26'E). Soils in the region are chalky sand and loam. The topography is characterized by gently rolling hills. The annual precipitation averages 570 mm and mean temperature is 9.8°C. During the winters (November-February) of 1980-84 maximum snow depth averaged 70 mm (range=10-240 mm), snowy days averaged 7 days (range=1-17 days).

The forest is dominated (30% cover) by old oak stands (*Quercus robur*, *Q. petraea*, *Q. cerris*). Other important species and their percent cover include acacia (*Robinia pseudoacacia*) 25%, and young, 8-10 years old pine (*Pinus silvestris* and *P. nigra*) forests, 22%. Other common trees include maple (*Acer* spp.), ash (*Fraxinus* spp.), lime (*Tilia* spp.), hornbeam (*Carpinus betulus*). Common shrubs include elder berry (*Sambucus* spp.), bramble (*Rubus* spp.), privet (*Ligustrum vulgare*), hawthorn (*Crataegus monogyna*), and a number of other species of trees and shrubs. Sour cherry (*Prunus serotina*) has been planted in alternative rows with pine. Surface areas covered by the same forest stand/age groups vary between 0.3-25 ha and sometimes hedged by honeylocust (*Gleditsia triacanthos*). Understories include rich grass and forbs vegetation. Occasionally, the edges of the forest border on agricultural fields which produce alfalfa and cereal crops. A stream of 1.5-2 m width bordered by narrow band (30-50 m) of alder (*Alnus glutinosa*) and willow (*Salix alba*) runs through the area. Beetroot (*Beta vulgaris*) has been placed at feeding places throughout the study area.

3. MATERIALS AND METHODS

Twenty red deer (17 adult and 3 calves) and 21 roe deer (17 adult and 4 fawns) rumen contents were collected during the months of November-February in 1982-84. Several studies have reported that diets of young animals did not differ from those of adults (Kie *et al.*, 1980, Spinage *et al.*, 1980). Eleven red and 10 roe deer rumen contents were sampled from pine plantations.

Ruminant diets can be approximated by microhistological analysis of rumen contents (Smith & Shandruk, 1979; Kessler *et al.*, 1981). Rumen contents were washed over a mesh series of 4 parts from 3.15 mm to 0.63 mm openings. Fractions remaining on the smallest mesh size were dried at 60°C for 24 hours. The smallest fragments of homogeneous size could minimize the bias of differing digestibility (Todd & Hansen, 1973). Three 0.01 g subsamples from dried material were measured, each boiled in a 20% nitric acid solution for 3 minutes, placed on slides into dark-blue solution of Toluidine-Blue (0.2%), covered, and examined by systematic

scanning under the microscope. All fragments found on the slides were recorded and identified, as far as possible, using a microhistological anatomical key (Mátrai *et al.*, 1986). Less than 1% of forbs and all of the bark fragments were not identified.

Percent of diet components was determined from the number of fragments for a particular species relative to the total number of fragments. The term grasses refers to grass and grasslike species, forbs to dicotyledonous herbs and mistletoe (*Viscum album*), browse involve pine, unidentified bark and other leaves and stems of trees and shrubs, while fruits indicate fruits, seeds and fungi. Plant species found at least 20% in rumen contents are shown to demonstrate the main diet components mostly contributing to the feeding connections among individuals. Within plant groups, differences in deer selection were determined by Wilcoxon two-sample test. Kulczyński's similarity (Oosting, 1956; in Clark, 1982) was used to estimate diet overlap. Comparisons of similarities within and between species according to pine and the other habitat types were made with a 2-way analysis of variance. Differences among means were tested with Duncan's new multiple-range test (Steel & Torrie, 1960). Single linkage cluster analysis was based on 66 correlation coefficients among all red and roe individuals with respect to the relative frequency of a diet component in their foods.

4. RESULTS AND DISCUSSION

The proportion of the main plant groups was not the same in the diet of the two ruminants except for browse species (Fig. 1). Within browse pine occurred in high proportion in red and roe deer diet (27% and 35%, respectively). Red and roe deer consumed the similar proportion of pine during winter (Siuda *et al.*, 1969; Gębczyńska, 1980). Blair *et al.*, (1977) have found that evergreen needles, browse leaves and twig tips were the most nutritious plants for white-tailed deer (*Odocoileus virginianus*). Conifers could be regarded as an important wintering food source due to

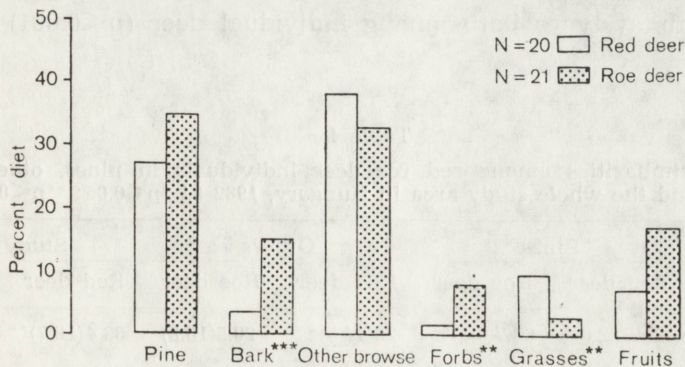


Fig. 1. Percent composition of red and roe deer winter diets in a forest habitat in Hungary, 1982-84. Level of significance * = <0.05; ** = <0.01 and *** = <0.001.

their protein, water and sugar content. However, volatile oil fractions of pine could inhibit the activity of rumen microbes (Schwartz *et al.*, 1980), it may be lost from ingested food as early as the mastication process (Cluff *et al.*, 1982). Longhurst *et al.*, (1968 in Carpenter *et al.*, 1979) speculated that juniper (*Juniperus*) and other conifers were salutary when taken occasionally.

Barking was more typical for red deer than roe deer ($p < 0.001$). It was also increased markedly by red deer during winter in Poland (Borowski & Kossak, 1975) and Britain (Welch *et al.*, 1987). Due to the high lignin content of bark, the cellulose and hemicellulose digestibility decrease drastically (Robbins & Moen, 1975). The causes of barking have not been established.

Browse was mainly complemented with grasses in red deer and fruits and forbs in roe deer diet. Red deer ate more grasses ($p < 0.01$) and less forbs and fruits ($p < 0.001$) than roe deer. Grasses are poorly digested (Blair *et al.*, 1977) and require a longer passage time for cellulose digestion. Fruits, especially legumes, and forbs are more easily digestible and nutritious than grasses (Short & Epps, 1976). Therefore, roe deer diet mostly consisted of plant groups that best meet their special morphophysiological characteristics (Hofmann, 1985).

Diet similarity was 28% between red and roe deer. Two species could differently overlapped depending on habitat characteristics (Table 1). Diet of elk (*Cervus canadensis*) and mule deer (*Odocoileus hemionus*) "moderately" overlapped (63%) in New Mexico during winter (Stephenson *et al.*, 1985), while less than 37% in Colorado (Hobbs *et al.*, 1983). Similarities in food choice between red and roe deer and among deer species were also strongly influenced by habitat types according to Dzieciolowski *et al.*, (1975). In pine habitat types similarities were higher than in the other habitat types both among individual deer ($p < 0.001$) and be-

Table 1

Mean (\pm SE) similarities among red roe deer individuals in pines, other habitat types, and the whole study area in Hungary, 1982-84 * $p < 0.05$; ** $p < 0.01$.

Similarity	Pines		Others		Study area	
	Red deer	Roe deer	Red deer	Roe deer	Red deer	Roe deer
Within species	45.9(22.0)	60.7(9.3)**	28(14.5)*	20.5(16.8)	33.4(18.7)**	27.8(22.1)
n	55	45	36	55	190	210
Between species	47.8(18.9)		20.3(15.3)		27.7(19.8)	
n	210		190		320	

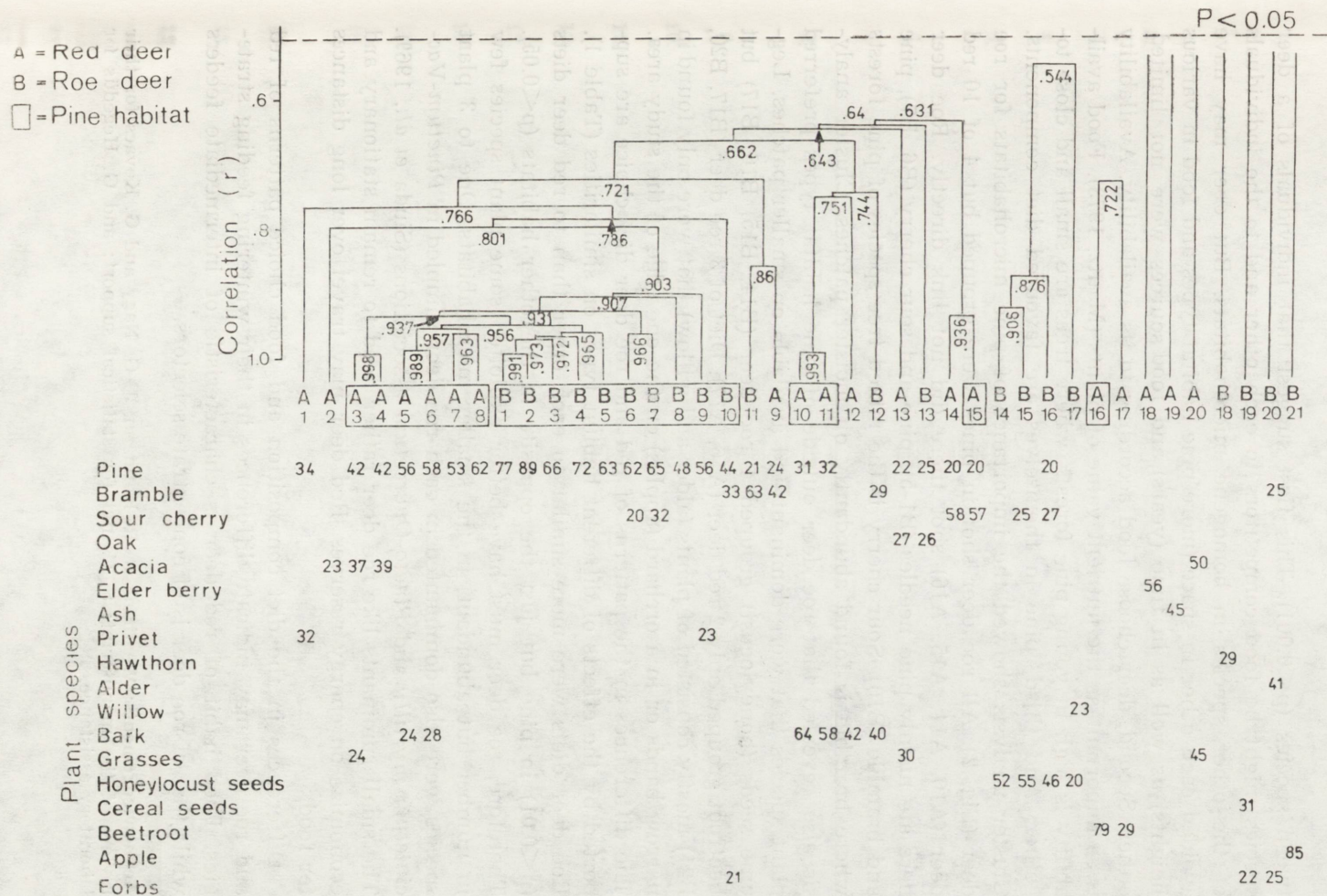


Fig. 2. Correlations among red deer (A) and roe deer (B) and plant species/groups found at least 20% in rumen contents in a forest habitat, in Hungary, 1982-84. Individuals (□) sampled from pine habitat types.

tween species ($p < 0.001$). This first suggest that individuals of a deer species might be food competitors to each other and to the individuals of the other species in homogeneous microhabitats. But deer may have avoided each other in space (more pine habitat types and food in various heights) as well as in time (years), and food sources were not limited either. Second, deer choose food according to its availability. Availability is as important as the nutrient value of plants (Mautz, 1973). Food availability is high in young pine forests, where trees are small and close together. And third, pine in themselves are favoured diet components. Cluster analysis showed the importance of pine microhabitats for roe deer (Fig. 2). All roe deer shot in pines were grouped but 4 of 10 red deer (A10, A11, A15, A16) shot there did not link directly. Roe deer here ate mainly pine needles (B1-5), pine and sour cherry (B6, B7), pine and bramble (B10). Sour cherry is the mixed tree species of pine forests where bramble is found abundantly on moister patches. Cluster analysis also revealed that roe deer outside of pine habitat types preferred plant species that were dominant and available on smaller patches. Legume seeds (honeylocust) grouped 4 roe deer (B14, B15, B16, B17) but beetroot grouped only 2 red deer (A16, A17). Diet of 3 roe deer (B17, B20, B21) mostly consisted of plants (alder and willow) that were only found in narrow bands or in an orchard (apples) on the one edge of the study area. The differences in the patterns of red and roe deer diet choice are supported by the effects of different habitat types on similarities (Table 1). Roe deer diets were more similar to each other than to red deer diets ($p < 0.01$) in pine but just the opposite in the other habitats ($p < 0.05$). Therefore, roe deer must have better exploited some plant species few in number but abundant, in the smaller microhabitats. One to 3 plant species were also dominated in each roe deer sampled in *Pinetum-Vaccinietum myrtilly* and *Pineto-Quercetum* associations (Siuda *et al.*, 1969). The small ruminants like roe deer rather need to remain stationary and economize on energy reserves. Red deer may travel over long distances for food.

Differences in the diet composition and food choice patterns of red and roe deer may indicate differences in their wintering feeding strategies. Food habit of red deer is characteristic of intermediate feeders while that of roe deer is of concentrate selectors.

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WYBIÓRCZOŚĆ POKARMOWA JELENI I SARN W ZIMIE W ŚRODOWISKACH LEŚNYCH NA WĘGRZECH

Streszczenie

Badano pokarm zimowy jeleni ($N=20$) oraz sarn ($N=21$) zamieszkujących środowiska leśne w oparciu o analizy histologiczne zawartości żwacza. Pędy drzew stanowiły 81% w pokarmie jeleni i 72% w pokarmie sarny (Ryc. 1), a sama sosna (*Pinus silvestris* i *P. nigra*) — odpowiednio 27% i 35%.

Stopień nakładania się nisz pokarmowych jeleni i sarn obliczony wg wskaźnika podobieństwa Kulczyckiego wynosił 28%. Selekcja pokarmu przez jelenie była typowa dla konsumentów pośrednich, natomiast przez sarny — dla konsumentów zdecydowanie wybiórczych (Tabela 1, Ryc. 2).