

**THE FOOD OF THE RED FOX (*VULPES VULPES* L) AND THE
MARTEN (*MARTES FOINA*, ERXL) IN THE SPRING-SUMMER
PERIOD IN OSOGOVO MOUNTAIN**

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ABSTRACT. There are no researches over comparative analyses of the food habits of red fox and marten in Bulgaria so far.

We collected and analyzed seasonal samples for our study from Osogovo mountain.

The frequency of occurrence (F%), the relative frequency (Fr%) and the volume (V%) of the food groups were determined. The width of food niche (B) was counted and the rate of overlap (C).

The main components of the food were separated in several groups (large mammals, birds, reptiles, rodents, insects, invertebrates, fish, fruit, other vegetables, garbage).

The analysed samples of scats of the red fox in spring show that the highest frequency of occurrence belongs to rodents (65,8%) and after to insects (35,4%). In the summer food of the red fox were not found: reptiles, fish, invertebrates, garbage. Insects were most frequently found (89,5%). The second place belongs to rodents (57,9%). The other three groups (large mammals, fruit and other vegetables) have one and the same F.

In the analysed marten's scats in spring we found that rodents were with highest rate of F (77,7%). Fruits take second place (63,0%) and insects third (29,6%). In summer we settled 4 groups of food. Insects are with highest frequency (F=69,6%), followed by rodents (56,5%) and fruit (47,8%).

Our analyses showed that the niche breadth of the red fox in spring was larger. For the summer and the whole period of researches there was no significant difference. The overlap of both niches is about 50%.

KEY WORDS. *Vulpes vulpes*, *Martes foina*, food habits, niche breadth

INTRODUCTION

In Bulgarian fauna there is only one species of genus *Vulpes* – the red fox. In Europe (short of Scandinavian peninsula, Spain and some island in the Mediterranean) lives subspecies *Vulpes vulpes Crucigera* Bechst., 1789 (Atanasov, 1958; Hepner et al., 1967). At present red fox is distributed in Europe, North America, North Africa and Australia. It inhabits quite different biotops.

Its diet is quite varied – grasshoppers, crickets and other invertebrates. The main part of the vertebrates belongs to small rodents (Atanasov, 1958; Grigorov, 1987). Pheasants, rabbits, grouses, as well as deer's and roe deer's cubs often become her victims. Annually it causes damages to poultry-farming (Lockie, 1959). Her instinct to kill much more poultry than it could take is quite harmful.

During the last years the number of marten (*Martes foina*) in Bulgaria and most of the European countries increased so much, that it inhabits not only fields and forests, but the central parts of the villages and towns.

Marten is not exactly a predatory animal. It is omnivorous and takes everything that the respective season offers. Daily it eats one tenth of its own weight, that means 100 to 200 grams. Its diet is quite various - bats, rodents, birds, even carrion. Sometimes it displays cannibalism but only against dead individuals of its kind.

The diet of the marten in Bulgaria is little studied and there is no data of comparative analyses of the diets and mutual relations of both species (*Vulpes vulpes* and *Martes foina*) either. As one of the most multiple species with the largest areas they take place at the present study.

MATERIAL AND METHODS

In the researches of the present study we used the method of the transects, which we visited monthly in spring and summer.

We collected totally 148 scats – 50 of them of martens - 34% of the total amount (27 in spring and 23 in summer) and 98 of red fox - 66% of the total amount (79 in spring and 19 in summer). They were analysed and the main groups of food, used by martens and red foxes in both seasons, were determined.

In our analyses we kept the following procedure

- each scat was moistened, after the macrocomponents were separated and grouped – bones, hair, parts of vegetables, stones, teeth, feathers, nails etc.
- the contents were separated in two main groups – animal and vegetable food.

The main components of the food were separated in several groups (large mammals, birds, reptiles, rodents, insects, invertebrates, fish, fruit, other vegetables, garbage).

The frequency of occurrence (F%) was determined. The rate of significance (Fr%) of the food categories (relative frequency of occurrence) was counted as a correlation of F to the total occurrence of a food category. The volume of each food group was also determined.

The food niche breadth (B) of red fox and marten in the studied seasons and totally was counted according to Levins' index:

$$B = 1 / \sum p_i^2 \quad (1)$$

B – niche breadth

p_i – relative frequency of occurrence of the food groups (rate of significance)

The rate of overlap (C) was counted according to Morista.

$$C = \frac{2 \sum p_{ij} p_{ik}}{\sum p_{ij} \left[\frac{n_{ij}-1}{n_j-1} \right] + \sum p_{ik} \left[\frac{n_{ik}-1}{n_k-1} \right]} \quad (2)$$

C – rate of overlap of niches

P_i – relative frequency of occurrence of the food categories (rate of significance)

n_i – number of samples, in which a current food group is found

n – total number of findings of the groups for each season (totally)

We used the χ^2 test to determine the authoritative differences in using the main food categories in the different seasons.

RESULTS

Frequency of occurrence and rate of significance of the food categories in the diet of the red fox in spring and summer.

The analyzed 79 scats in spring showed that Rodents are with highest frequency of occurrence in the food of the red fox - 65,8% of all the samples, that means 39,7% rate of significance. Insects take the second place – they were found in 35,4% of the samples and their rate of significance (21,3 %) also takes the second place. In that season there are no other fruits except those of the juniper and wild briar. Their frequency of occurrence is 24,0 % and their rate of significance takes the third place with 14,5%. The same is valid also for the place of Large mammals in the diet of the red fox - the natural death causes and the autumn hunting season lead to a certain presence of adult feral pigs and roe deer remains which basically is not natural prey of the red fox. The situation with the piglets' remains is quite different. They are usually born in spring and could easily become a victim of the foxes. The frequency of occurrence of that group is 16,5 %, and its rate of significance is 10,0%. Reptiles, Other vegetables, Invertebrates, Birds and Garbage are with lower frequency of occurrence. Fish remains were found in only one sample. (Table 1).

In the summer food of the red fox were not found: Reptiles, Fish, Invertebrates and Garbage. In that season Insects have the highest frequency of occurrence – in 89,5% of the samples, with rate of significance 47,3%. Rodentia takes the second place with 57,9% frequency of occurrence, and 31,0% rate of significance. One and

the same frequency of occurrence have the rest three food categories: Large mammals, Fruit and Other vegetables. (Table 1).

According to χ^2 test, there is no significant difference in the frequency of occurrence between the different food categories and that allowed us to unite them. As a result, Rodents turned out to be most frequently found in the samples - in 64,3% of them, and their rate of significance is 37,7%. They are followed by Insects, found in 45,9% of the samples, with rate of significance 27,0%. Fruit take the third place, found in 21,4% of the samples. Their rate of significance is 12,6%. These are the main food categories, found in over 20,0% of the samples.

Volume proportion of the food categories in spring and summer in the diet of the red fox.

The volume proportion of the food categories in the diet of the red fox in spring and summer is shown in Table 2.

Rodents take the biggest part of the volume of the food in spring (42,1%). Insects take the second place in this season with 18,8% and the third place belongs to Large mammals (13,0%). In summer the part of the insects in the diet is 49,0%, noticed also in the frequency of occurrence; they are followed by Rodents, which take 38,9% of the volume of the food. The other three food categories take no significant place in the diet. It is not possible to unite the seasons here, because there is a significant difference in the number of the used food categories in both seasons.

Frequency of occurrence and rate of significance of the food categories in the diet of the marten in spring and summer.

The analyzed 27 scats in spring showed that, Rodents have the highest frequency of occurrence. That food category was found in 77,7% of the samples. Their rate of significance is 37,5%. The second place belongs to Fruit, found in 63,0% of the samples, and their Fr% = 30,4%. Insects take the third place, found in 29,6% of the samples, with rate of significance = 14,3%, (Table 3).

We collected 23 samples in summer. Unlike spring, when the food categories in the diet of the stone marten were 7, in summer they decreased to 4. Insects have the highest frequency of occurrence – 69,6%. Their relative frequency is 39,1%. Rodents were found in 56,5%, Fr% = 31,7%. The third place belongs to Fruit which have frequency of occurrence 47,8%, and rate of significance 26,8%.

Here, again, according to χ^2 test, there is no significant difference in the frequency of occurrence and the rate of significance between the different food categories and that allowed us to unite them and obtain the following data: in both seasons Rodents have the highest frequency of occurrence – 68,0%, and rate of significance - 35,1%. Fruit take the second place- F = 56,0%, Fr = 28,9%. Insects were found in 48,0% of the samples, and their relative frequency is 24,7%.

Volume proportion of the food categories in spring and summer in the diet of the marten.

Rodents take the biggest part of the volume of the food in the diet of the marten in spring and summer, respectively V = 49,3%, V = 43,6%. VFruit = 28,5%, 28,9%. Unlike spring, when the part of Insects is 8,7%, in summer it grows up to 25,3%. The percentage of the volume of Large mammals – on the contrary - decreased. (Table 4).

χ^2 test

We did that test to verify if a significant difference between the volume of the food categories in the diets of the fox and the marten exists. Our analysis showed that:

- There is a significant difference in the use of Insects and Fruit in spring. In summer the differences concerns Insects, Birds, and Fruit.

Food niches

Our analyses on niche breadth of the studied species showed that the one of the red fox was larger in spring. For the summer and the whole period of researches there was no significant difference, (Table 6). The rate of overlap of both niches was studied. The difference in spring and summer was found to be insignificant. Totally the overlap of both niches is about 50%.

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Table 1. Number of samples, frequency of occurrence and rate of significance of the different food categories in the diet of the red fox in spring and summer in Osogovo mountain.

Food Category	spring			summer			both seasons		
	Nr. of samples	Frequency of occurrence %	Rate of signif. %	Nr. of samples	Frequency of occurrence %	Rate of signif. %	Nr. of samples	Frequency of occurrence %	Rate of signif. %
Large mammals	13	16,5	10,0	2	10,5	5,5	15	15,3	9,0
Birds	1	1,3	0,8	2	10,5	5,5	3	3,1	1,8
Reptiles	5	6,3	3,8	0	0	0	5	5,1	3,0
Rodents	52	65,8	39,7	11	57,9	30,6	63	64,3	37,7
Insects	28	35,4	21,3	17	89,5	47,3	45	45,9	26,9
Fish	1	1,3	0,8	0	0	0	1	1,0	0,6
Fish	19	24,1	14,5	2	10,5	5,5	21	21,4	12,6
Other vegetables	6	7,6	4,6	2	10,5	5,5	8	8,2	4,8
Invertebrates	2	2,5	1,5	0	0	0	2	2,0	1,2
Garbage	4	5,1	3,0	0	0	0	4	4,1	2,4
Totally	131	165,9	100	36	189,4	100	167	170,4	100

Table 2. Volume of the food categories in the diet of the red fox in spring and summer in Osogovo mountain.

	Large mammals	Reptiles	Rodents	Insects	Fish	Birds	Fruit	Other vegetables	Invertebrates	Garbage
Spring	13,0	2,0	42,1	18,8	0,4	0,6	11,3	6,4	2,2	2,7
Summer	0,5	0	38,9	49,0	0	5,3	4,5	1,7	0	0

Table 3. Number of samples, frequency of occurrence and rate of significance of the different food categories in the diet of the marten in spring and summer in Osogovo mountain.

Food Category	spring			summer			both seasons		
	Nr. of samples	Frequency of occurrence %	Rate of signif. %	Nr. of samples	Frequency of occurrence %	Rate of signif. %	Nr. of samples	Frequency of occurrence %	Rate of signif. %
Large mammals	3	11,1	5,0	1	4,3	2,0	4	8,0	4,0
Birds	0	0	0	0	0	0	0	0	0
Reptiles	2	7,4	4,0	0	0	0	2	4,0	2,0
Rodents	21	77,7	38,0	13	56,5	32,0	34	68,0	35,0
Insects	8	29,6	14,0	16	69,6	39,0	24	48,0	25,0
Fish	0	0	0	0	0	0	0	0	0
Fish	17	63	30,0	11	47,8	27,0	28	56,0	29,0
Other vegetables	4	14,8	7,0	0	0	0	4	8,0	4,0
Invertebrates	1	3,7	2,0	0	0	0	1	2,0	1,0
Garbage	0	0	0	0	0	0	0	0	0
Totally	56	207,3	100	41	178,2	100	97	194	100

Table 4. Volume of the food categories in the diet of the marten in spring and summer in Osogovo mountain.

	Large mammals	Reptiles	Rodents	Insects	Fish	Birds	Fruit	Other vegetables	Invertebrates	Garbage
Spring	10,5	0,6	49,3	8,7	0	0	28,5	1,5	0,9	0
Summer	2,2	0	43,6	25,3	0	0	28,9	0	0	0

Table 5. Significant differences in the volume of the food categories in the diets of the fox and the marten in spring and summer by χ^2 test.

	Large mammals	Reptiles	Rodents	Insects	Fish	Birds	Fruit	Other vegetables	Invertebrates	Garbage
Spring RF / M	n.s.	n.s.	n.s.	0,04	n.s.	n.s.	0,002	n.s.	n.s.	n.s.
Summer RF/ M	n.s.	n.s.	n.s.	0,0004	n.s.	0,025	0,000	n.s.	n.s.	n.s.

Table 6. Seasonal differences in niche breadth (B) of the marten and the red fox and rate of overlap (C).

Season	Marten	Red fox	C
Spring	3.80	4.20	0,47
Summer	3.05	3.04	0,49
Both seasons	3.96	3.96	0,48