N O T E

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Diet composition of red fox during rearing in a moor: a case study

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A b s t r a c t . The diet of red fox (*Vulpes vulpes*) cubs living in a moor in Hungary was studied by scat analysis (n = 77) during the rearing period. The main food source of foxes consisted of small mammals (preferred *Microtus* voles) which was supplemented with brown hare and gamebirds rarely. Cubs ate remains of carrions (domestic animals, ungulates and carnivores) and invertebrates frequently but in low quantity. The food consisted of characteristically terrestrial, occasionally aquatic and rarely arboreal prey.

Key words: *Vulpes vulpes*, cubs, *Microtus* preference, Hungary

Introduction

Red fox *Vulpes vulpes* (L.) is a generalist predator, widely spread and common species in Europe (L l o y d 1980). In Hungary, the red fox population has increased in recent years (in 1988: 4.9 ind./1000 ha, in 2001: 12.8 ind./1000 ha, H e l t a i 2002). The diet in spring and summer is primarily composed of small mammals, and in addition to these, also birds, hare, fruits and carrion are important e.g. on meadows, woods and agricultural landscapes in central Europe (S u c h e n t r u n k 1984, G o s z c z y n s k i 1986, K o ž e n á 1988, J e d r z e j e w s k a & J e d r z e j e w s k i 1998). Compared to other habitats, the feeding habits of fox in the shrinking moor areas (L e c k i e et al. 1998), especially in the Pannonian region are less known. Moreover, the qualitative and quantitative characteristics of the food that the vixen supply the cubs with (K o l b & H e w s o n 1980, L l o y d 1980) are also described to a lesser extent. The aim of this case study was to investigate the diet and feeding habits of red fox living in a moor during the cubs' dependency stage.

Material and Methods

The study area, named Nagybereki Fehérvíz Moor Nature Conservation Area is situated in western Hungary (46°38' N, 17°32' E, 99 m a.s.l.). The typical vegetations of this area are mire willow scrubs (*Salicetum* spp.), large sedge communities (*Carex* spp.) and alder swamp wood (*Cariceti elongatae-Alnetum*). A rich fen is located on the area, which is periodically used as cow pasture.

The diet of the red fox were studied by scat analysis. Samples (n = 77) were collected between 14 April 2002 to 18 July 2002 around a fox den. Prey determination was performed by microscope on the basis of feather, bone, dentition and hair characteristics (more detail: L a n s z k i 2003). Diet composition was expressed as the relative frequency of occurrence and as an estimate of the percentage fresh weight (biomass) of food consumed (J e d r z e j e w s k a & J e d r z e j e w s k i 1998). Survey of the small mammal food

resources of primary importance was carried out in wetland habitats in August 2002; this involved live trapping (four nights, 149 traps), by mark-recapture method (K r e b s 1989).

Standardized trophic niche breadth was calculated in accordance with Hurlbert (K r e b s 1989). The following food taxa were used in the calculation: voles, mice, brown hare, carcasses of domestic animals and carnivores, carcasses of ungulates, birds, other vertebrates, invertebrates and plant matter. Ivlev's index of preference (E_i, varies from – 1.0 to +1.0.) according to small mammal taxon was applied (K r e b s 1989). SPSS 10 (1999) statistics program was used for processing data.

Table 1. Diet composition of red fox during raising period in the Nagybereki Fehérvízi Moor, Hungary. O%: percentage relative frequency of occurrence, B%: biomass (%), +: occurring in proportions lower than 0.05%, n = 77 samples.

Item	N	O%	B%
Microtus voles	46	24.3	37.3
Bank vole *Clethrionomys glareolus*	1	0.5	2.1
Water vole *Arvicola terrestris*	12	6.3	19.3
Muskrat *Ondatra zibethicus*	1	0.5	0.6
Field mouse *Apodemus* spp.	4	2.1	2.3
Rat *Rattus* spp.	1	0.5	0.2
Ground squirrel *Spermophilus citellus*	5	2.6	5.8
Brown hare *Lepus europaeus*	3	1.6	8.0
Brown hare *Lepus europaeus*, juv.	5	2.6	5.1
Stoat/weasel *Mustela* spp.	2	1.1	0.6
Otter *Lutra lutra*	1	0.5	2.1
Domestic cat	2	1.1	7.3
Cattle	1	0.5	1.7
Medium-sized mammals	1	0.5	1.5
Wild boar *Sus scrofa*, adult	8	4.2	1.1
Wild boar *Sus scrofa*, juv.	10	5.3	1.2
Red deer *Cervus elaphus*, juv.	1	0.5	0.2
Small passerines Passeriformes spp.	8	4.2	1.3
Medium-sized birds	2	1.1	0.5
Bird eggs	1	0.5	0.5
Snakes Colubridae spp.	1	0.5	+
Lizards Sauria spp.	5	2.6	0.1
Unidentified Cyprinidae spp.	1	0.5	+
Carabid beetles Carabidae spp.	23	12.2	0.1
Cockchafer *Melolontha* spp.	7	3.7	0.1
Other invertebrates	31	16.4	0.2
Maize *Zea mays*	1	0.5	0.7
Other plant matter	5	2.6	0.2

Results and Discussion

The study of samples collected near the den focused mainly on the investigation of the food supply of the cubs of the vixen living on the moor. The cubs (at least two individuals) lived predominantly around the den during the three months period investigated. The study was terminated in the partial dependence period of the cubs (L l o y d 1980), when the food was still mainly provided by the vixen. According to the investigation of K o l b & H e w s o n (1980), cubs eat essentially the same foods as the adults, in this period. On the basis of biomass calculations, two-thirds of the diet consisted of open field living small mammals (Table 1). Foxes preferred *Microtus* species (E_i = 0.88), primarily common vole *Microtus arvalis* (M a c d o n a l d 1977), living in terminally dry large sedge communities and in dry grass; avoided bank voles (E_i = -0.80), field mouse species (E_i = -0.82) and insectivores (E_i = -1.00).

Foxes mark territorial boundaries predominantly with faeces in the geometric centre of their territory (M a c d o n a l d 1980). Faeces scattering by adults around the central den is not typical; this was supported by the fact that scats were not to be found near the den, neither before the birth of cubs, nor after the period of independence. The dry weight of washed and dried scats were only one-third of those found for adult foxes (L a n s z k i & H e l t a i 2002) in a winter-early spring study in the region studied (mean±SE: 0.50±0.41, n=77, vs. 1.52±0.86, n=76, $P<0.001$, two samples t-test). It can hypothesize that the scats of the vixen could only be poorly represented in the samples analyzed. The remains of medium and larger animals (from hunting or scavenging, Table 1) are brought to the den, which the cubs often play with (L l o y d 1980), though they also consume from this source to some degree. The high frequency of occurrence, but low biomass proportion of wild boar also indicates this. The relatively high insect and lizard consumption may mainly be attributed to the learning of hunting techniques. Due to the large distance of the moor from settlements (3.1 km) and agricultural areas (1.1 km), spring and summer consumption of domestic animals and brown hare was lower than in other studies in Hungary (E r d e i 1977, L a n s z k i et al. 1999). Lagomorphs and gamebirds were less important food taxa of fox than on Scottish moorlands (K o l b & H e w s o n 1979, 1980, L e c k i e et al. 1998) in opposition to small rodents. In spite of the dominance of wetland habitats, foxes consumed species associated to wetlands infrequently. The food consisted of characteristically terrestrial (86%), occasionally aquatic (10%) and rarely arboreal (4%) prey. The trophic niche was narrow (B_{sta} = 0.38 and 0.17, on the basis of frequency of occurrence and biomass estimation), due to the dominance of Microtus voles, although the diet of fox contained numerous species (Table 1). This provided the cubs the opportunity to recognize various prey species and to use them effectively when becoming adults. This may, at least in part, explain the feeding and habitat generalism of fox, and also its quick expansion (H e l t a i 2002).

A c k n o w l e d g e m e n t s

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