

THE FEEDING HABITS OF THE RED FOX (*VULPES VULPES* LINNAEUS, 1758) IN DIFFERENT LANDSCAPES AND SEASONS IN LATVIA

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Fox is in Latvia one of the most common predators, but it is still a rather unexplored species.

The aim of the study was to investigate the feeding habits of red fox in Latvia, using faecal analysis.

A total of 284 faeces were collected between July 2006 and March 2009 in different territories of Latvia.

The scats contained mainly voles of the genus *Microtus* (FO = 57,14% summer, FO = 48,35% winter), which is also the basic food of foxes. The amount of deer family (FO = 6,59% summer, FO = 27,47% winter), birds (FO = 8,79% summer, FO = 14,29% winter) and plant food (FO = 31,87% summer, FO = 31,87% winter) was also notable.

The research was carried out in the Faculty of Biology of the University of Latvia in the Laboratory of Experimental Life Sciences from autumn 2006 to spring 2009.

Key words: fox, feeding habits, seasons, landscape, Latvia.

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INTRODUCTION

Red fox (*Vulpes vulpes* Linnaeus, 1758) is an opportunistic predator (Lindström 1982), widely spread and common species in Latvia and the rest of Europe (Tauriņš 1982). The predator's diet consists mainly of small rodents, where the most important food items are voles from the genus *Microtus* (Schränk, 1798). Birds (*Aves*) and wild even-toed ungulates (*Artiodactyla*) compose quite a considerable part in the food

ration of these predators too (Goszczyński 1974, Kožená 1988, Labhardt 1990, Jędrzejewska & Jędrzejewski 1998, Baltrūnaitė 2002, Гуманов 2003). The diet composition of fox may vary depending on the habitat where it lives (Юдин 1986, Labhardt 1990) or several seasonal factors as thickness of the snow layer (Lindström 1982). As there is no data on this subject in Latvia, the aim of the study was to investigate the diet and feeding habits of *V. vulpes* in different landscapes in Latvia in both (warm and cold) seasons.

Table 1. The coordinates and radii of the sampling sites

Number of sampling site	Rural municipality of sampling site	Coordinates of sampling site	Radii of sampling site
1	Kolka r.m.	X-416419 Y-6402310	5,12 km
2	Kolka r.m.	X-415034 Y-6401958	3,71 km
3	Lapmežciems r.m.	X-464259 Y-6298330	5,04 km
4	Viļķene r.m.	X-541047 Y-6388149	4,55 km
5	Vecumnieki r.m.	X-533873 Y-6265390	6,46 km
6	Mētriena r.m.	X-646926 Y-6286278	6,93 km
7	Rušona r.m.	X-688459 Y-6234821	6, 56 km

MATERIAL AND METHODS

The diet of *V. vulpes* was studied by fecal analysis. There were seven sampling sites chosen throughout the territory of Latvia, from which three were selected to be compared as different landscapes (Nr 1,5,6) (Table 1). Site Nr. 1 was a seaside landscape with forest patches of coniferous trees nearby, whereas the other two sites were agricultural lands with a few patches of shrubs, in case of Nr. 5 and Nr. 6 – meadows which alternate with deciduous tree forests. The seasonality of the predator's diet was studied in these three landscapes separately as well as in the whole territory of Latvia.

During the three-year study period (2006-2009) a total of 284 red fox scats were collected. They were analyzed as described by Goszczyński (1974). The macroscopic food remains were identified according to key-books (Sloka & Tauriņš 1956, Pētersons & Birkmane 1980, Sedlag 1986, Görner & Hackethal 1988, Stichmann 2005, Zorenko 2008) and the structure of microscopic hair samples was determined using the keys of Teerink (1991).

The study data was divided in two seasons: warm (July – August) and cold (October – February) having regard of the specific weather conditions in Latvia during these months. The consumed biomass (BC, %) and frequency of occurrence (FO, %) were established as well as food niche breadth (B) was determined by using Levin's measure for niche breadth (Krebs 1998).

RESULTS

The study shows that the diet composition of *V. vulpes* in Latvia can contain diverse food objects. Food items were divided into 13 components (Tables 2-3).

The main food source for foxes in Latvia during both seasons is small rodents; especially the voles from genus *Microtus* (58,97% BC - summer; 48,07% BC - winter). Rodents from other genera are not important food components as their consumed biomass is rather small during both seasons. Other significant food items are wild ungulates, birds and plant food. The consumption of birds and mammals from the deer family (Cervidae) increases during winter.

Table 2. Diet composition of red fox in Latvia in summer (July – August) and winter (October – February) seasons (BC, % - biomass consumed; FO, % frequency of occurrence; N – number of samples; B – food niche breadth)

Food items	Summer		Winter	
	BC, %	FO, %	BC, %	FO, %
<i>Microtus</i> sp.	58,97	57,14	48,07	48,35
<i>Arvicola terrestris</i>	4,13	4,40	0,00	0,00
<i>Myodes glareolus</i>	1,85	2,20	2,56	4,40
<i>Apodemus</i> sp.	4,43	5,49	0,69	1,10
Mustelidae	0,00	0,00	0,00	0,00
Lagomorpha	5,50	3,30	6,30	4,40
Cervidae	6,60	6,59	17,50	27,47
<i>Sus scrofa</i>	0,00	0,00	3,24	1,10
Aves	6,90	8,79	15,18	14,29
Amphibia	1,10	1,10	0,00	0,00
Reptilia	0,13	2,20	0,04	1,10
Insecta	0,59	42,86	0,15	14,29
Plantae	9,80	31,87	6,25	31,87
N	91		91	
B	2,68		3,40	

Insects (Insecta) have a very high frequency of occurrence during summer (42,86% FO), but this cannot be considered as a significant food component of the predator's ration, because the consumed biomass of insects is comparatively low (0,59% BC) (Table 2).

Comparing three different landscapes in Latvia it is obvious that voles from the genus *Microtus* are an important food source of fox in each of the study area. However, it can be considered as the main food object only in Vecumnieki (Table 1, Nr.5) rural municipality (r.m.) and in Mētriēna r.m. (Table 1, Nr.6) during summer (whereas the deer family is the main food item in winter (42,59% BC)). In the sampling site which was near the sea shore (Table 1, Nr.1) birds appear to be as important food components as *Microtus* voles during both seasons. Plant food is common in the ration of the red fox, but its quantity varies in different landscapes.

Food niche breadth of *V. vulpes* is similar in both seasons looking at all the sampling sites together (Table 2). Comparing the different landscapes, the predator in Kolka r.m. (Table 1, Nr.1) has a much wider food niche in summer, but in Vecumnieki r.m. (Table 1, Nr. 5) the food niche considerably narrows during winter (Table 3).

DISCUSSION

The study's results prove that the feeding of the red fox has a seasonal character in Latvia. Similar discoveries have been made in earlier studies in Europe (Kožená 1988, Jędrzejewska & Jędrzejewski 1998, Baltrūnaitė 2002, Sidorovich et al. 2006).

Voies of the genus *Microtus* are an important food source for *V. vulpes* in all seasons and landscapes. Other small rodents can be found occasionally in the predator's ration. Remains from the bank

Table 3. Diet composition of red fox in three landscapes (Kolka r.m., Mētriena r.m., Vecumnieki r.m.) during summer (July – August) and winter (October – February) seasons (BC, % - biomass consumed; FO, % frequency of occurrence; N – number of scats; B – food niche breadth)

Kolka r.m.				
Food items	Summer		Winter	
	BC, %	FO, %	BC, %	FO, %
<i>Microtus sp.</i>	26,71	33,33	38,88	36,67
<i>Arvicola terrestris</i>	0,00	0,00	0,00	0,00
<i>Myodes glareolus</i>	4,18	6,67	2,16	10,00
<i>Apodemus sp.</i>	7,74	10,00	0,00	0,00
Mustelidae	0,08	3,33	0,00	0,00
Lagomorpha	14,25	10,00	0,00	0,00
Cervidae	11,10	23,33	10,52	20,00
<i>Sus scrofa</i>	4,47	3,33	0,32	3,33
Aves	23,05	23,33	36,97	40,00
Amphibia	0,00	0,00	0,00	0,00
Reptilia	0,00	0,00	0,00	0,00
Insecta	1,04	20,00	0,30	33,33
Plantae	7,37	20,00	10,85	53,33
N	30		30	
B	5,80		3,21	

Mētriena r.m.					Vecumnieki r.m.			
Food items	Summer		Winter		Summer		Winter	
	BC, %	FO, %	BC, %	FO, %	BC, %	FO, %	BC, %	FO, %
<i>Microtus sp.</i>	61,88	56,67	28,13	23,33	65,74	63,33	84,79	73,33
<i>Arvicola terrestris</i>	0,00	0,00	0,00	0,00	12,99	13,33	0,00	0,00
<i>Myodes glareolus</i>	5,53	6,67	6,30	3,33	0,00	0,00	0,00	0,00
<i>Apodemus sp.</i>	3,58	3,33	0,00	0,00	3,69	6,67	2,32	3,33
Mustelidae	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Lagomorpha	11,71	6,67	20,55	10,00	0,00	0,00	2,75	3,33
Cervidae	12,11	20,00	42,59	56,67	0,00	0,00	0,29	3,33
<i>Sus scrofa</i>	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Aves	0,24	3,33	0,25	3,33	0,00	0,00	0,00	0,00
Amphibia	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Reptilia	0,36	3,33	0,15	3,33	0,00	0,00	0,00	0,00
Insecta	1,08	60,00	0,33	6,67	0,05	16,67	0,22	23,33
Plantae	3,51	16,67	1,69	16,67	17,54	43,33	9,63	50,00
N	30		30		30		30	
B	2,40		3,26		2,08		1,37	

vole (*Myodes glareolus* Schreber, 1780) were not found in the samples taken from Vecumnieki r.m. (Table 3). It could be because this particular vole prefers to live in forests (Zorenko 1983), whereas this sampling site can be described as an agricultural landscape.

Mammals from the deer family become a significant prey for the red fox during winter (Table 2). These can be animals which could have died during harsh winters or carrions left by larger predators. Also it is proved that the fox is capable to hunt deer fawns if other food resources are low (Kjellander & Nordström 2003, Jarnemo et al. 2004). In site Nr. 5 (Mētriēna r.m.) during winter Cervidae becomes an even more significant food object than small rodents (Table 3). This could be because the climate in this area is more continental compared to the other two landscapes and so the snow layer is much thicker (Latvian Environment, Geology and Meteorology Centre data). Also this is an area abundant in larger predators that possibly leave carrions (Žunna 2005).

Wild boar (*Sus scrofa* Linnaeus, 1758) was found only in the samples of Kolka r.m. (Table 3). This was most likely carrion and has no major significance as it is not known that the red fox preys on wild boars.

The frequency of occurrence of birds during winter is in Latvia (14,3% FO) (Table 2) much higher than Lithuania (3,9% FO). This could be explained by the fact that two of this study's sampling sites were in Kolka r.m., near the sea and Cape Kolka where large bird migrations can be observed. *V. vulpes* preys on young, inexperienced birds during their migration period and it also feeds on the dead ones that get washed ashore (Юдин 1986, Cynthia & Spencer 1989). For the same reason birds is a significant food item in the seaside landscape (Table 1, Nr.1) compared to the other two landscapes (Table 3). In Lithuania the study was carried out in a clay plain landscape (Baltrūnaitė 2002).

Hares (Lagomorpha) cannot be considered as a significant food item for red fox in Latvia. The

importance of hares as a food resource increases towards north (Туманов 2003).

Looking at the data of consumed insects, the frequency of occurrence in the predator's ration is very high. This can be explained by the availability of this food object in summer, as well as the fact that *V. vulpes* uses insects as an extra source of proteins (Kožená 1988, Labhardt 1990). Significant food objects for foxes are also plant food. The fact that its frequency of occurrence is so high during winter season (31,87% FO) (Table 2) is because in this study October was also considered a part of the cold season, and in Latvia it is a period where the fox can easily access such fruits as apples and plums. It is also mentioned in previous studies that the predator uses the fruits of fall season to accumulate food reserves for winter (Юдин 1986; Labhardt 1990). Plant food was found in the predator's feces more often in places where humans lived not far from the sampling site – Kolka r.m. and Vecumnieki r.m. (Table 3).

The food niche breadth of the red fox changes according to the landscape where the predator hunts. The widest food niche was observed in the sampling site near the sea (Table 1, Nr.1) during summer (Table 3). As this landscape contains both – a seashore habitat and a coniferous tree forest habitat, the red fox is able to choose prey that is accessible depending on several factors (season, weather anthropogenic factors etc.). The most narrow food niche was observed in Vecumnieki r.m. (Table 1, Nr. 1) during winter. This landscape can be characterized by agricultural lands, thus the predator does not have many options what to prey on. Only seven food items were found in both seasons in this landscape, and *Microtus* voles were the major nutritional component (Table 3). In Latvia small rodents are abundant in agricultural lands (Zorenko 1983).

CONCLUSIONS

The voles from genus *Microtus* are the major component in the diet of the red fox, although the predator can feed on other items if they are more

accessible, like birds at the sea shore or carrion during winter.

The feeding habits of the red fox can be influenced by the season as well the landscape where it preys. Agricultural landscapes are less advantageous for the predator, because these are not so abundant as species as other landscapes.

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REFERENCES

- Baltrūnaitė L. 2002. Diet composition of the red fox (*Vulpes vulpes* L.), pine marten (*Martes martes* L.) and racoon dog (*Nyctereutes procyonoides* Gray) in clay plain landscape. Lithuania. *Acta Zoologica Lithuanica*, 12 (4): 362 – 367.
- Cynthia J. Z., Spencer J. T. 1989. Shift in red fox, *Vulpes vulpes*, mating system associated with El Niño in the Bering Sea. – Institute of Marine Studies, *Applied Science Building*, University of California, Santa Cruz, CA 95064 U.S.A.: 830 – 838.
- Görner M., Hackethal H. 1988. Säugetiere Europas. Leipzig. *Neumann Verlag*, 203 – 225.
- Goszczyński J. 1974. Studies on the food of foxes. *Acta Theriologica*, 19: 1 – 18.
- Jarnemo A., Liberg O. Lockowandt S., Olsson A., Wahlström K. 2004. Predation by red fox on European roe deer fawns in relation to age, sex and birth date. – *Canadian Journal of Zoology*, 82 (3): 416 – 422.
- Jędrzejewska B., Jędrzejewski W. 1998. Predation in Vertebrate Communities: The Białowieża Primeval Forest as a Case Study. Berlin. Springer Verlag. 450.
- Kjellander P., Nordström J. 2003. Cyclic voles, prey switching in red fox, and roe deer dynamics – a test of the alternative prey hypothesis. *OIKOS*, 101: 338 – 344
- Kožená I. 1988. Diet of the red fox (*Vulpes vulpes*) in agrocoenoses in southern Moravia. *Acta scientiarum naturalium Academiae scientiarum bohemoslovaecae*. Brno, 22 (7): 1 – 24.
- Krebs Ch. J. 1998. Ecological methology. Second edition. Vancouver, University of British Columbia. 624.
- Labhardt F. 1990. Der Rotfuchs. Hamburg und Berlin: Verlag Paul Parey, S. 158.
- Lindström E. 1982. Population ecology of the red fox (*Vulpes vulpes* L.) in relation to food supply. Stockholm: Department of Zoology University of Stockholm and Grimsö Wildlife Research Station. 24.
- Pētersone A., Birkmane K. 1980. Latvijas PSR augu noteicējs. Rīga. Zvaigzne. 589.
- Sedlag U. 1986. Insekten Mitteleuropas. Leipzig, *Neumann Verlag*, S. 408.
- Sidorovich V. E., Sidorovich A. A., Izotova I. V. 2006. Variations in the diet and population density of the red fox *Vulpes vulpes* in the mixed woodlands of northern Belarus. *Mammalian Biology*, 71 (2): 74 – 89.
- Sloka J., Tauriņš E. 1956. Latvijas PSR dzīvnieku noteicējs II. Mugurkaulnieki. Rīga, Latvijas valsts izdevniecība: 261 – 263.
- Stichmann W. 2005. Der große Kosmos – Naturführer. Tiere und Pflanzen. Stuttgart, Kosmos: S. 895.

Tauriņš E. 1982. Latvijas zīdītājdzīvnieki. Rīga,
Zvaigzne. 166 – 170.

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Teerink B. J. 1991. Hair of West – European
Mammals. Cambridge: Cambridge University
Press. 224.

Zorenko T. 1983. Kā dzīvo strupastes. Rīga,
Zinātne: 93.

Zorenko T. 2008. Latvijas zīdītāju noteicējs. Rīga.
Gandrs. 31 – 39.

Žunna A. 2005. Vilka *Canis lupus* populācijas
stāvoklis pēc sugas aizsardzības plāna
ieviešanas Latvijā: izplatība, struktūra un
barošanās ekoloģija. Maģistra darbs. Rīga.
LU. 62.

Туманов И. Л. 2003. Биологические
особенности хищных млекопитающих
России. Санкт – Петербург. *Наука*, 49 – 52.

Юдин В. Г. 1986. Лисица Дальнего Востока
СССР. Владивосток: ДВНЦ АН СССР.
284.