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Comparative Ecological Studies on Blackbird (Turdus merula) and Song Thrush (T. philomelos) Populations. I. Nutritional Ecology

By

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Abstract. The food of nestlings of blackbirds and song thrushes was studied over a period of five years in various habitats. Food samples were obtained by placing neck-collars on the nestlings. Blackbirds consumed mainly lepidopterous larvae, dipterans and coleopterans. Besides great quantities of lepidopteran larvae and dipterans, song thrushes fed on more annelids and less beetles than the blackbirds. The blackbird proved to be a more generalist and mobile species than the song thrush. These properties have enabled the blackbird to easily penetrate into urbanized areas. Of the two studied niche dimensions (food composition and prey size) of the sympatric populations, there was greater degree of segregation betwen the species in food composition.

Introduction

The blackbird and the song thrush are the two most common species of the genus *Turdus* in Hungary. In Europe the blackbird is distributed mainly in the south-eastern parts. The range of the song thrush considerably overlaps with that of the previous species but penetrates much further north, and is absent from some parts of southern Europe (Dyrcz, 1969; Nilsson, 1979).

Besides similar geographical distribution, similar habitat preference is characteristic for the two species, though the blackbird is more common in certain habitats (reedbeds, orchards) than its congener. The penetration of the blackbird into urban habitats modified by man (synurbanization) was a clearly definable and rapid process (Kroll, 1975). In some parts of Europe the song thrush has also moved into towns, but the blackbird has been able to maintain its numerical predominance even in these habitats (Snow, 1958).

In the breeding season both species feed in a clearly definable microhabitat, on the surface of the soil, and their prey searching tactics are similar (Smith, 1973; Tye, 1981).

There are few comparative studies on the food composition of blackbirds and song thrushes (Eble, 1963; Dyrcz, 1969), therefore the primary objective

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of the present work was to study the food segregation in sympatric populations of the two congeneric species. Detailed knowledge of the food resource utilization of the blackbird and the song thrush may help us understand the different adaptivities of the two species, and may provide further data to the phenomenom of resource segregation that has recently been widely studied in closely related species (CODY, 1974; DYRCZ, 1969; HARTLEY, 1953; JENNI, 1983; LACK, 1945, 1971; MACARTHUR, 1958).

Study areas

No. *1* (12 ha): A dry Turkey-oak woodland (Quercetum petraeae cerris) in the vicinity of Budapest, with dense shrub vegetation at the edges (*Ligustrum vulgare, Sambucus nigra, Cornus mas, Crataegus* sp. and *Rosa* spp.).

No. *2* (12 ha): An orchard contiguous with study area No. 1. bordered by a Turkey-oakwood in the north and north-east, by cultivated land in the south (wheat) and by a meadow in the west. The composition of the orchard is as follows: winter apple (4.5 ha), peach (2 ha), apricot (1.5 ha), pear (1.3 ha), plum (1.3 ha), cherry (0.7 ha) and sour cherry (0.7 ha).

No. *3* (4 ha): An old hornbeam-oakwood mixed with beech in a hilly suburb of Budapest (Normafa), with young oak saplings in the undergrowth.

No. *4* (4 ha): A Turkey-oak woodland with dense edge vegetation in the outskirts of Törökbálint. There is an extensive peach plantation under large-scale mechanized farming adjacent to the wood. The nests were located in the 200 m wide strip of the oakwood.

No. *5* (9 ha): A recreational park in the centre of Budapest. The varied vegetation is patchily distributed. *Quercus* spp., *Acer* spp., *Juniperus* spp., *Thuja plicata, Taxus baccata* and *Forsythia europea* may be found in larger numbers.

No. *6* (2 ha): A resort area in the outskirts of Esztergom with varied cultivated vegetation, small plots with vegetable gardens and fruit orchards, with rows of bushes (*Ligustrum vulgare, Sambucus nigra, Rosa* spp.) and trees *(Robinia pseudoacacia, Juglans regia, Acer campestre, Aesculus hippocastanum)* along the roads and inbetween the plots. The nests were located in the rows of bushes along the road.

Study periods and methods

The study was carried out between 1978 and 1982. I collected food samples by placking neck-collars on the the nestlings throughout the five years in study area No. 1, in 1979, 1980 and 1982 in study area No. 2 and in 1980 in study areas Nos 3, 4, 5 and 6. A detailed description of the method is found in TÖRÖK (1981). The collected prey animals were measured to mm accuracy and preserved in isopropyl alcohol until identification. I separated 9 size intervals (each 5 mm) for the calculations. If only one individual could be ascertained in the sample, the length of earthworms was calculated as the total length of the pieces found in the sample. If several head or tail parts were found in the sample, then the sizes of the aimals could only be estimated as based on the diameters of the pieces.

Nestlings were weighed on every second day to 0.1 g accuracy. No food samples were taken from these nestlings.

Following TINBERGEN (1960) and BALEN (1973), I estimated the abundance and dynamics of the leaf-consuming lepidopterous larvae by collecting the excrements of the caterpillars. Thirty carton sheets each 0.25 m^2 in size were laid out in study area No. 1 to collect the excrements for 48 hrs at 10-days intervals. The excrements collected over the two days were weighed after cleaning and airldrying.

Niche metrics

I calculated food niche width from the SHANNON formula (SHANNON & WEAVER, 1949),

$$H = -\sum_{i=1}^{s} \frac{n_i}{N} \log_2 \frac{n_i}{N}.$$

Evenness was computed using the formula $J = \frac{H}{H_{max}}$

where $H_{max} = \log_2 s$ (PIELOU, 1969).

In the above formulae n_i is the number of prey items belonging to the ith prey or size category, N is the total number of prey specimens, and s is the number of prey categories.

The degree of niche overlap was calculated using RENKONEN's similarity formula (RENKONEN, 1938),

$$s_{1-2} = \sum_{i=1}^{s} \min(p_{1,i}, p_{2,i}),$$

where $p_{1,i}$ is the frequency of the ith prey or size category in sample *1* relative to the total number of prey items, $p_{2,i}$ is the same for sample 2.

During calculating food composition I considered the various semaphoront populations of most prey categories as separate entities because of their different habitats, feeding habits and mobilities. In the above calculations the term food category is usually equivalent to the taxonomical category of the family, but in certain cases when the prey could be identified only to the order, this taxon was considered a category.

Food composition

Based on 3833 collected prey items, it was found that the predominant food of the blackbird is lepidopterous larvae. Of the noctuids, *Orthosia* and *Agrochola* species, of the geometrids *Operophtera brumata, Colotois pennaria, Erannis* and *Boarmia* species occurred in considerable numbers. Although blackbirds feed on the surface of the soil, caterpillars living typically on herbs or in the soil were found only in low percentage in the food. The nestlings consumed approximately equal numbers of Diptera and Coleoptera. Among dipterans the most abundant were Tipulida and *Limonia* species which emerge in May. The order Coleoptera was primarily represented by members of the family Elateridae, Carabidae, Scarabaeidae and Silphidae. I often found among the food species like *Calosoma inquisitor* and *Dendroxena quadripunctata* which feed on carterpillars. Annelida, Hymenoptera, Heteroptera and Araneidae were found only in few numbers among the food samples collected from the blackbird nestlings. Among the annelids, species of the genera *Allolobophora* and *Lumbricus* were predominant. The species which inhabit the upper soil layers (*Lumbricus* spp., *Dendrobaena* spp.) outnumbered three to one those which live deeper in the soil (*Allolobophora* spp., *Octolasium* spp.). The same ratio was as high as four to one in the case of the song thrush. I found remains of any vertebrate species only on one occasion, the

Table 1. Food niche width (H) and eveness (J) of the blackbird and the song thrush (s – number of categories, N – number of prey items, 1–6 – study plots)

		1978	1979		1980						1981	1982
		1	1	2	1	2	3	4	5	6	1	2
Turdus merula												
prey taxon	H	4.64	4.10	3.53	4.53	4.82	4.15	4.07	1.85	1.69	3.29	3.16
	J	0.85	0.71	0.80	0.73	0.91	0.84	0.85	0.58	0.73		
	s	44	56	21	77	40	31	28	9	5		
	N	247	770	67	768	121	104	98	53	15	1272	318
prey size	H	2.32	2.69		2.55	2.49	2.80	2.71	2.02	2.47	2.45	2.16
	J	0.77	0.85		0.80	0.83	0.88	0.85	0.64	0.88		
	s	8	9		9	8	9	9	9	7		
	N	247	770	67	768	121	85	89	48	15		
Turdus philomelos												
prey taxon	H	3.51	3.03		3.49	3.42				3.10	2.32	3.15
	J	0.90	0.96		0.69	0.71				0.76		
	s	15	9		34	28				17		
	N	28	11		220	199				38	167	91
prey size	H	2.15	2.18		2.23	2.68				2.79	2.31	1.88
	J	0.92	0.91		0.70	0.85				0.88		
	s	5	5		9	9				9		
	N	20	11		220	199				32		

tail part of a young slow-worm. When feeding the young, the birds also consume plants as well (sour cherry), but the proportion of this food item is not significant.

In the urban environment artificial food (of human origin) were also found in the collected samples, but here the predominant prey categories were also earthworms and Diptera. In the samples from the oakwood in the outskirts of Budapest Lepidoptera and Diptera, in the samples from the Normafa Annelida and Coleoptera were the most significant prey categories. In the orchard, the samples from June of 1979 and 1982 contained mainly Coleoptera and Diptera, those from the end of May, 1982 contained Hymenoptera and Coleoptera in considerable numbers.

Similarly to the food of the blackbirds, that of the song thrush contained mainly lepidopterous larvae and Diptera. Of the caterpillars primarily species of the genera *Orthosia* and *Boarmia*, and *Operophtera brumata* and *Colotois pennaria* were fed to the nestlings, of the dipterans *Tipula* and *Limonia* species. Earth worms, molluscs and isopods were taken in greater proportion by song thrushes than blackbirds, and at the same time the former species took less Heteroptera and Diplopoda than the latter one. The proportion of plant material was also insignificant in this species, but about ten times that in the blackbird. The contents of the food samples from the orchard were characterized by Lepidoptera and Coleoptera, those from the woods by Lepidoptera and Diptera. In the study area at Esztergom mainly Coleoptera, Lepidoptera and Neuroptera were fed to the nestlings.

I found sand, gravel, earth and snail shells among the food of both species, but have not included them among the items. These are taken partly to help grind the food particles, partly to supplement the supply of inorganic elements (e. g. Ca).

Niche width of the blackbird was greater than that of the song thrush (Table 1). I did not include the samples from 1978 and 1979 in the results because of the small quantity of song thrush food collected in those years.

The similarity between the food composition of the two species was lower than that between the distributions of the size categories. The food samples collected from blackbirds in the oakwood resembled each other to a much greater degree than any other sample (Tables 2 and 3).

Temporal variation in food composition

I studied the variation in food composition of blackbirds by pooling the samples into 10-days intervals (Fig. 1). The diversity and and evenness of the food composition was greater at the beginning and end of the breeding season than in the middle. In early spring Coleoptera, Annelida and Diptera predominated because of the paucity of caterpillars in that season, whereas in summer besides annelids and beetles caterpillars were also taken. These groups were taken in approximately equal proportions by the birds.

From the middle of May to the beginning of June foliage-consuming caterpillars were predominant in the food samples. This group reached its maximum in biomass around 20 May, as shown by the measurements of the quantity of caterpillar excrements in 1979 (Fig. 1). The exact timing of the "caterpillar peak" may vary from year to year because of differences in weather (BALEN, 1973), but it occurs usually at the end of May. With the sudden increase in the abundance of the caterpillars the thrushes shifted to this prey category, and at the expense of other food items the larvae became the predominant food. Therefore the diversity and evenness of the food decreased during this period. The abundance of caterpillars decreased shortly after the peak, but their proportion was still considerable in the food of the nestlings.

Table 2. Similarities between food compositions

		1978	1979	1980	1981	1982
T. merula	– *T. philomelos*					
	1. study plot	0.42	0.33	0.48	0.51	
	2. study plot			0.28		0.37
1. study plot	– 2. study plot					
	T. merula		0.26	0.31		
	T. philomelos			0.38		
1. study plot	– 4. study plot					
	T. merula			0.39		
1. study plot	– 3. study plot					
	T. merula			0.24		
3. study plot	– 4 study plot					
	T. merula			0.17		

Table 3. Similarities between prey sizes

		1978	1979	1980	1981	1982
T. merula	– *T. philomelos*					
	1. study plot	0.89	0.75	0.78	0.74	
	2. study plot			0.81		0.75
1. study plot	– 2. study plot					
	T. merula			0.78		
	T. philomelos			0.76		

Prey size

Niche width of the blackbird, calculated from the pooled data as well as from the yearly data from the oakwood in the vicinity of Budapest, was greater than in the song thrush. In the orchard and the Esztergom study site, however, the niche width of the song thrush was the greater one in 1980. The differences were small in both cases.

There was considerable similarity between the prefered size categories as well. The interspecific prey size similarity was also high in various years and in the various habitats (Table 3). Within the species, the niche overlap of food size was also high between the various habitats.

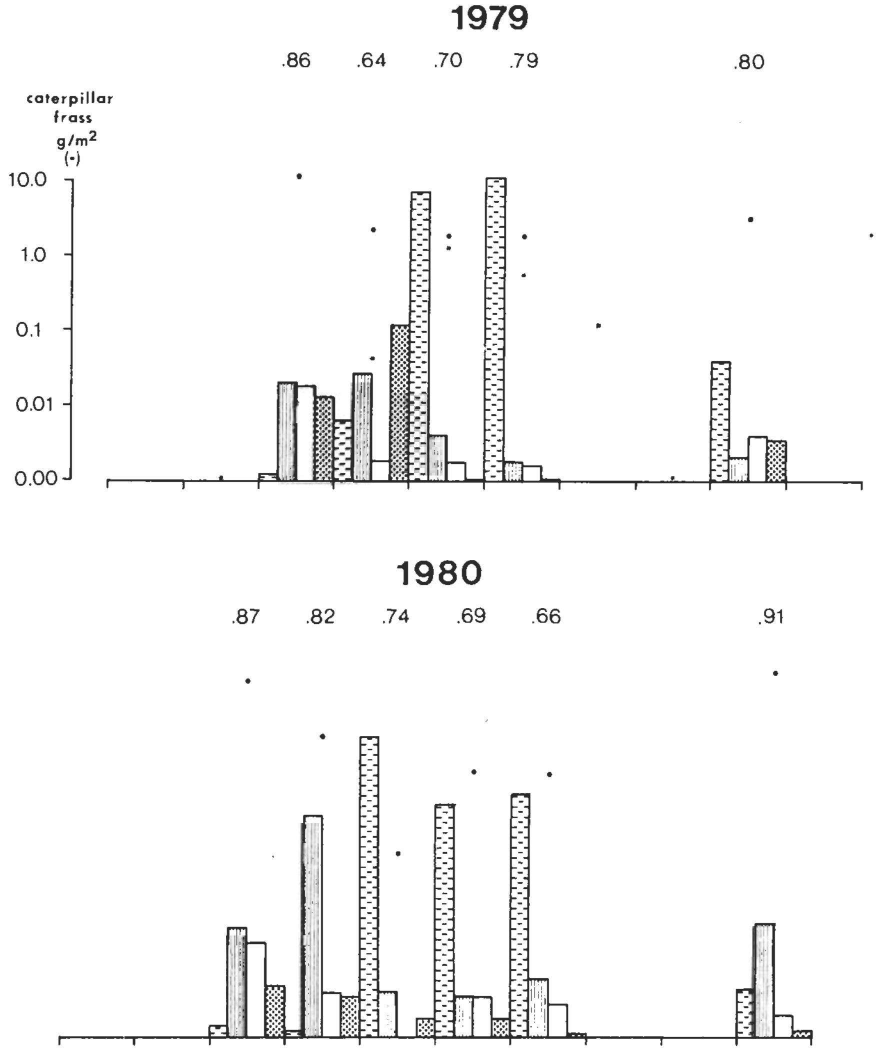
Changes in food composition with the growth of nestlings

The equations of logistic growth are widely used to describe the growth patterns of small passerines (RICKLEFS, 1967, 1968). I obtained the following equations for the growth curves (in body mass) of the blackbird (Tm) and song thrush (Tp) from the measurements of nestlings in study areas Nos 1 and 2:

$$wt_{Tm} = 54.5\,/1 + e^{-0.647(t-3.896)} \qquad (N = 38)$$

$$wt_{Tp} = 43.1\,/1 + e^{-0.714(t-3.718)} \qquad (N = 11)$$

where wt is the body mass (in g) at time t, which is the age of the nestling in days, N is the number of individuals.



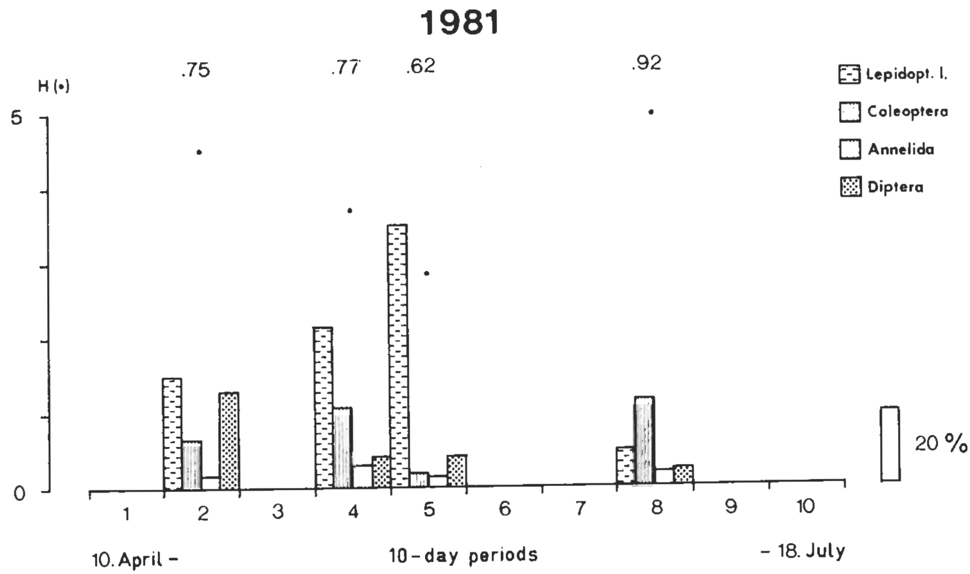


Fig. 1. Temporal variation of food composition and niche width of the blackbird in three years

The growth of the blackbirds and song thrushes is rapid, similarly to other altricial bird species which construct their nests in uncovered situations. They fledge on day 11 or 12 after hatching, though their ability to fly is still poor. Of the two species studied, the smaller song thrush has a greater growth rate (0.714). The hatching and fledging weights of the larger blackbird are greater than in the song thrush. The weight at hatching expressed as percentage of the asymptotic weight is about equal in the two species (Tm = 12.4%, Tp = 11.0%).

Food composition changed with the growth of the nestlings (Fig. 2.) In the samples from study area No. 1 collected in 1978, the younger nestlings of both species were fed mainly soft invertebrates (e. g. earthworms). With the growth of the nestlings the proportion of Coleoptera, lepidopteran larvae and diplopods increased and at the same time the proportion of Annelida and Hymenoptera decreased.

Discussion

The literature on avian ecology is rich in studies on sympatric populations of closely related species. The primary objectives of these studies had been elucidation of the interspecific similarities, mechanisms of segregation, competitive interrelationships, and clarification of the causes of different adaptivities, all of which lead to a better understanding of the regulatory mechanisms responsible for the structuring of avian communities. The present paper deals with the food of two species of the genus Turdus, the blackbird and the song thrush, which are abundant over much of Europe.

The results of the present work suggest that, similarly to other temperate birds, these two species are generalists. The difference between the species is manifested in the narrower food niche of the song thrush as compared with that

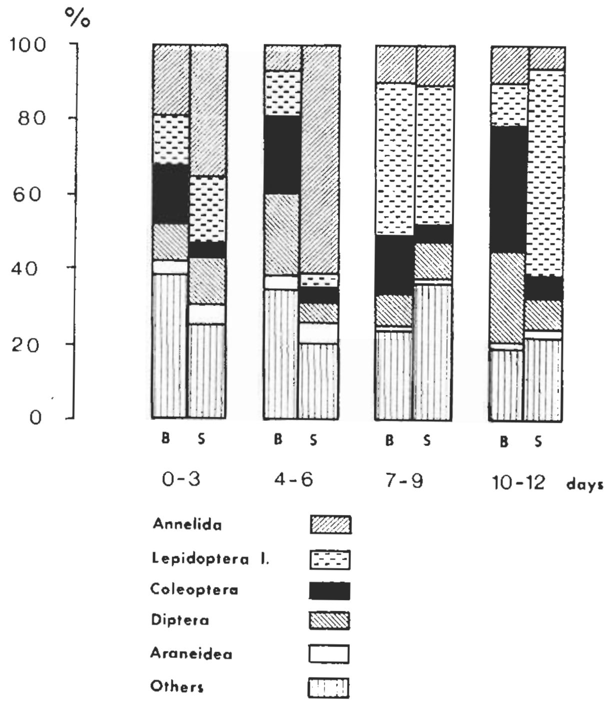


Fig. 2. Changes in food composition and the growth of nestlings (B = blackbird, S = song tursh)

Table 4. Average precipitation and dry weight of earthworms collected by blackbirds over 10-day periods (L – Lumbricus spp., D – Dendrobaena spp., A – Allolobophora spp., O – Octolasium spp., r – correlation coefficient, ns – nonsignificant correlation, x – the relative proportion of earthworms to total number of prey)

	10-day periods							r
	1	2	3	4	5	7	8	
	30.04 –						– 18.07.	
1979								
Precipitation (mm)	0.8	0.0	2.4	0.6	–	2.5	–	
L + D	.17*	.05	.03	.03	–	.12	–	0.548 ns
A + O	.08	.005	.004	–	–	–	–	–0.200 ns
Total	.25	.05	.05	.04	–	.12	–	0.003 ns
1980								
Precipitation (mm)	1.7	2.1	–	1.9	2.8	–	0.7	
L + D	.17	.12	–	.07	.03	–	.05	–0.090 ns
A + O	.07	–	–	.03	.05	–	–	–0.170 ns
Total	.25	.12	–	.11	.09	–	.06	0.093 ns

*Table 6. Principle food items of blackbirds and song thrushes from literature data (Only categories exceeding 10% of total prey indicated). Methods of food collection: + – analysis of stomach contents * – neck-collared nestlings □ – observation*

	Blackbird						Song thrush					
	Annelida	Coleoptera	Lepidoptera	Gastropoda	Hymenoptera	Plant food	Annelida	Coleoptera	Lepidoptera	Gastropoda	Hymenoptera	Plant food
Csiki (1908)+		×						×		×		
Siivonen (1939)+								×				×
Eble (1963)+		×				×						
Mustafaeva (1964)								×			×	×
Davies and Snow (1965)□							×		×	×		
Korodi (1967)*	×	×	×									
Dyrcz (1969)*	×	×	×			×	×		×	×		
Vauk and Witting (1971)+		×		×		×						
Havlin (1977)+		×				×		×		×		
This study*		×	×				×		×			

of the blackbird. As regards actual food composition, the song thrush takes softer prey in greater quantities than the blackbird which shows preference for harder prey.

In both species lepidopterous larvae predominated in the food of the nestlings, the majority of which was made up by foliage-consuming caterpillars. Since these larvae live in the foliage and the thrushes feed on the surface of the soil, only in the period subsequent to the larval peak did the proportion of caterpillars increase in the food taken to the nestlings, when the larvae moved down to the soil to pupate.

Within the other prey category of importance, Diptera, the *Tipula* and *Limonia* species of poor flying ability which emerge in May predominated (mainly females full with eggs). The majority of other dipteran species were immediately after they had emerged from population and were yet unable to fly. Fully developed dipterans of powerful flying ability were found only rarely among the food items.

Both blackbirds and song thrushes consumed considerable quantities of earthworms. Presumably both the species living in deeper soil layers (*Allolobophora* spp., *Octolasium* spp.) and the ones near to the surface (*Lumbricus* spp., *Dendrobaena* spp.) are brought to the surface by sufficient rainfall and thus become susceptible to depredation by birds. To substantiate this presumption, I calculated for each 10-day period of 1979 and 1980 the dry weight of earthworms consumed by the nestlings (because of the uncertainty in estimation of the number of individuals), its relative proportion to total food and compared with the average precipitation of the periods (Table 4). I found no significant correlation between the amount of earthworms consumed and the amount of rainfall. Therefore it is probably not because of rainfall that earthworms are present in the food, though in spring, when there is more rainfall, they are taken in greater numbers to the nestlings than in the dryer period of the summer (Snow, 1958).

*Table 5. The common spider species of the litter layer of Turkey oakwoods (Loksa, unpublished data) A — abundance, * — spring, early summer period, + — for juveniles only, B — total number consumed by blackbird nestlings*

Species	A/m²	size of cephalothorax (mm)	Activity	B
*Pardosa lugubris**	8.0 – 10.4	2.5 – 3.0	diurnal quickly moving	1
Micryphantidae spp.	1.6 – 10.2	1.0 – 2.0	nocturnal	—
Linyphidae spp.	3.2 – 9.6	1.9 – 2.4	nocturnal	9
Leptyphantes flavipes	3.2 – 6.4	1.0 – 1.5	nocturnal	—
Trochosa terricola	1.6 – 6.4 (9.6)+	3.7 – 5.0	nocturnal	3
Harpactes rubicundus	1.6 – 4.8	3.5 – 4.5	nocturnal	19
Dysdera erythrina	1.6 – 4.8 (9.6)+	3.0 – 4.0	nocturnal	1
Xysticus cambridgei	1.6 – 3.2	3.5	nocturnal	6
Oxyptila spp.	1.6 – 3.2	2.0 – 2.5	nocturnal	3

Because of the seaching tactics of the thrushes, spider species which do not occur on the surface of the soil were found only rarely in the food, though large numbers were taken of some species, e. g. *Xysticus lanio.* Of the species commonly ocurring in the litter layer of the Turkey oakwood, principally the ones of greater dimensions and slow locomotion were captured (Table 5). JANSSON and BRÖMSSEN (1981) found in their studies in coniferous forests that the birds' predation on the larger spiders was greater than on the smaller ones.

A number of authors have found molluscs to be important (DAVIES & SNOW, 1965; DYRCZ, 1969; SNOW, 1958), but except study area No. 3, where slugs were important prey, snails occurred only in small quantities in the food of the nestlings. The cause of this discrepacy may be that the forests in Hungary are drier and hence poorer in molluscs than the habitats in England and Poland, where the above observations have been reported from. CSIKI (1908) and HAVLIN (1977) also reported high proportion of molluscs, though these findings may reflect the inadequancy of the stomach analyses, in which the proportion of animals with highly chitinized integumen or calcified shell is greater than the proportion taken (Table 6).

RICKLEFS' generalization (1968), that of the closely related species the larger ones have lower growth rates, proved to be valid for the two *Turdus* species. The younger animals feed on softer food, the older ones take harder prey categories. KORODI (1967) also found that during the growth of blackbird nestlings the proportion of Coleoptera increased and that of the spiders and Lepidoptera decreased.

The food compositions of the generalist thrush species are closely related to the food resources of their environment (Table 7.). At the beginning of the breeding season, when the thrushes took even proportions of the various prey categories, the food composition niche width of the thrushes was great. Caterpillars, which play a central role in the food of most passerines, become the predominant food of the birds when they are available and thus the food niche width of the thrushes decreases. Even when a prey category becomes superabundant, the thrushes take other prey as well because besides the energy requirements of the nestlings, other circumstances also influence the search for prey (ROYAMA, 1970;

Table 7. Temporal variation in food composition of the two thrush species from literature data. (Only categories exceeding 10% of total prey indicated, in decreasing order of percentile proportion. Abbreviations: Co – Coleoptera, An – Annelida, Di – Diptera, Ga – Gastropoda, He – Heteroptera, Hy – Hymenoptera, Le – Lepidoptera)

	April	May	June	July
Turdus merula				
KORODI (1967)	Co, He, Hy, An	Le, Co	Le, Co	Le, Co, An
This study	–	Co, Di, An	Le, Co	Le, Co, An
Turdus philomelos				
DAVIES and SNOW (1965)	An, Ga	An, Le	Le, An	Ga, An
DYRCZ (1969)	–	An, Di, Ga	Co, Ga, Di, An	Co, Le, Ga
This study	–	An, Di, Le	Le, An	–

TINBERGEN, 1982). With the decrease in availabity of the caterpillars, other items are also taken and thus the food spectrum and the food niche width decreases.

Of the two studied niche dimensions, the similarity between prey sizes of the two species was greater than that between food composition. The similarities between food compositions of the species and habitats show that the food resourches of the given habitat determine the food composition of the two species. In an altered habitat, the orchard, considerably changed as compared with the natural habitat of the oakwood, the food of the song thrush changed to a lesser extent than that of the blackbird, indicating that this species does not readily follow the changes in its food resources. This fact, coupled with a smaller food niche width, indicates the specialized food regime of the song thrush that is accompanied by a less mobile dietary shift than that characteristic for the blackbird.

Appendix 1. Food of blackbirds (B) and song thrushes (S) in the study areas (1–6)

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
Annelida																				
Lubricidae																				
Lumbricus rubellus			2			3				3			3						8	3
L. spp.	4		32	3	2	49	6	9	3	11	2	6	6	8					119	22
Allolobophora caliginosa	2																		2	
A. rosea	6					1		5				1							12	1
A. spp.	1	3	3		1	16		5				3	1						25	8
Dendrobaena octaedra	1																		1	
D. spp.	1					1			1			3	2	8					3	13
Octolasium spp.			4			1													5	
Lumbricidae indet.	3	4	8	1		5	3	4			1	4	2	1	49	20	8	1	82	32
Enchytraeidae																				
Fridaericia sp.						2	1	2											5	
Enchytraeidae indet.						1													1	
Mollusca																				
Enidae																				
Zebrina detrita						9			1				11						10	11
Arionidae			1					11		1		1			2				15	1
Helicidae															1	5	3	3	4	8
Gastropoda indet.						1			1				8						2	8
Arthropoda																				
Isopoda																				
Porcellionidae																				
Porcellio scaber										1									1	
P. collicola						3	3		1				1				2		9	1
P. spp.														2						2
Protracheoniscus amoaenus		1	3	2		4	5	2				1					2		18	2
Ortometapon planum													1							1
Armadillidiidae																				
Armadillidium vulgare	1		1										18				3	1	5	19
A. sp.																	1		1	
Oniscoidae indet.	1					1			1						11	2	1	1	15	3

Diplopoda																				
Glomeridae																				
Glomeris hexasticha			3			2	2	2					1		6				15	1
Julidae																				
Ophiiulus fallax						12	3					1	2						15	3
Chromatoiulus projectus			5			4	1		4	1									15	
C. unilineatus																	1		1	
Schizophyllum sabulosum						1		2											3	
S. sp.										1									1	
Cylindroiulus boleti						4													4	
Brachiiulus littoralis													1							1
Julidae indet.	3														19	1	5		27	1
Polydesmidae																				
Polydesmus complanatus																	3		3	
P. spp.															1		1		2	
Chilopoda																				
Cryptopidae																				
Cryptops parisi							1	3											4	
Cryptops sp.	1																		1	
Heniidae																				
Henia illyrica			1					4	2			1							7	1
Scolioplanes acuminatus						1													1	
Geophilidae																				
Clinopodes flavidus						1		1	2										4	
Geophilus insculptus								1											1	
Lithobiidae																				
Henicops fulvicornus							1												1	
Lithobius forficatus							1	4											5	
L. muticus			3	1		1	3		1										9	
L. mutabilis						1													1	
Monotarsobius austriacus			1																1	
Lithobiidae indet.																	1		1	
Chilopoda indet.	2														12		2		16	

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
Collembola																				
Sminthuridae																				
Sminthurus lubbocki							1												1	
Blattidea																				
Ectobiidae																				
Phyllodromica sp.						1													1	
Blattidea indet.			1														2		3	
Orthoptera																				
Tettigoniidae																				
Pholidoptera griseoaptera				1															1	
Pachytrachis gracilis															1				1	
Isophya sp.													1							1
Tettigoniidae indet.						1						1			4	1		1	5	3
Tetrigidae																				
Tetrix bipuctata																1				1
T. nutans														1						1
Acrydiidae																				
Chorthippus parallelus							1								2				3	
Glyptobothrus apricarius							1												1	
G. brunneus							1												1	
G. spp.							3												3	
Stenobothrus crassipes							4												4	
Acrydiidae indet.						2	1							1	8	1	9	4	20	6
Orthoptera indet.																1				1
Dermatoptera																				
Forficulidae																				
Forficula auricularia	5		1			1											2		9	
Chelidurella acanthopygia						5		10				2			23				38	2

Heteroptera																				
Miridae																				
Calocoris ochromelas						2									1				3	
Cyllocoris lutens													1							1
Miris dolombratus							1												1	
Miridae indet.	2	1	1			2									121	2	8		134	3
Nabidae																	1		1	
Pyrrhocoridae																				
Pyrrhocoris apterus														1						1
Coreidae																	3		3	
Pentatomidae																				
Palomena prasina	1					2		1							3				7	
Dolycoris baccarum								1											1	
Eurydema ornatum								1											1	
Stollina melanocephala								1											1	
Pentatomidae indet.																	8	1	8	1
Scutelleridae																				
Eurygaster testudinaria								1											1	
Scutelleridae indet.																	1		1	
Heteroptera indet.	2					4	1								16	2	1	1	24	3
Homoptera																				
Cicadidae																				
Cicadetta tibialis							1												1	
C. spp.					1							1					2		2	2
Cicadidae indet.																	1		1	
Membracidae																				
Centrotus cornutus															2				2	
Homoptera indet.															1		3		4	
Neuroptera																				
Raphidiidae																				
Raphidia flavipes	1														3		1		5	
R. sp.						2			1						1				4	

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
Raphidiidae larvae indet.							1								3	1	1		5	1
Hemerobiidae																				
Micromus angulatus						2													2	
Hemerobius nitidulus															1				1	
Drepanepteryx phalaenoides																	2	1	2	1
Hemerobiidae indet.															1				1	
Hemerobiidae larvae indet.																		2		2
Inocelliidae																				
Inocellis crassicornis															1				1	
Chrysopidae																				
Chrysoperla carnea												1					2	3	2	4
Chrysopa formosa																		3		3
C. perla																		6		6
C. phillocroma																	1	1	1	1
Hypochrysa nobilis												1								1
Chrysopidae indet.												1			2				2	1
Chrysopidae larvae																				
Chrysoperla carnae																	2		2	
Chrysopa perla															1				1	
C. spp.									3					1					3	1
Neuroptera indet.						1									1				2	
Mecoptera																				
Panorpidae																				
Panorpa communis															5	1	2		7	1
Coleoptera																				
Carabidae																				
Calosoma inquisitor	1		8			8									23				40	
Carabus cancellatus						1	1												2	
Pterostichus cupreus	2																		2	

P. vulgaris	1																		1	
P. spp.			1					1											2	
Harpalus rufipes			2																2	
H. smaragdinus			1																1	
H. psittaceus							1												1	
H. affinis								2											2	
H. spp.	2					1	2												5	
Abax parallelepipedus							1	1											2	
Zabrus tenebrioides							1												1	
Amara saphyrea							1	1											2	
A. familiaris								1											1	
A. similata								1											1	
Agonum pellidum													1							1
Ophonus spp.						1	1												2	
Bembidion sp.								1											1	
Carabidae indet.	6														13	1	6	2	25	3
Molops piceus								1											1	
Carabidae larvae indet.	3		9	6		3	2	5	1						5	2	2	8	36	10
Staphylinidae																				
Ocypus olens	1																		1	
Platydrocus caesareus						2													2	
Xantholinus spp.				1									1						1	1
Aleochara sp.						1													1	
Phylanthus sp.								1											1	
Staphylinidae indet.			1												1				2	
Staphylinidae larvae indet.						2	4	2						1	9		4		21	1
Melyridae																				
Dasytes plumbeus						1													1	
Silphidae																				
Dendroxena quadripunctata	4		10			15		2							23		1		55	
Silphidae larvae indet.			1	2		2	9								2		13	1	29	1
Tenebrionidae																				
Cylindronotus aeneus			9			2			4						3				18	
Tenebrionidae larvae indet.															1				1	

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
Scarabaeidae																				
Onthophagus coenobita			5				5												10	
O. verticicornis			3			7	1												11	
Aphodius aequestris							1												1	
Scarabaeidae indet.															7				7	
Melolonthidae																				
Melolontha melolontha	7	1	1			1			2										11	1
Miltotrogus aequinoctialis	4	1	2			2							1						8	2
Rhizotrogus aestivus						4		1							7				12	
Amphimallon solstitialis	2				1										2				4	1
Melolonthidae indet.	1		1												5		1		8	
Cetoniidae																				
Cetonia a aurata lavra						1													1	
Cantharidae																				
Cantharis fusca			3			1													4	
C. obscura		1	3														1		4	1
C. rustica																	1		1	
Metacantharis haemorrhoidalis			1																1	
Malachius spp.		1																2		3
Cantharidae indet.															11				11	
Cantharidae larvae																				
Lampyris noctiluca						7													7	
Cantharis sp.												1								1
Elateridae																				
Prosternon tesselatum			6			3													9	
Selatosomus latus						2						1							2	1
Athous rufus			41																41	
A. haemorrhoidalis						1	1					2							2	2
Pseudathous hirtus						1													1	
Melanotus castanipes						4													4	
M. sp.			1																1	

Adelocera murina			8																8	
Agripus murinus						1													1	
Elateridae indet.	25	1	1			1									10	1	5	2	42	4
Elateridae larvae		1	6			6	2					2			2	2			16	5
Alleculidae																				
Gonodera luperus						4													4	
Cerambycidae																				
Stenocorus quercus						1													1	
S. meridianus						3													3	
Anaglyptus mysticus						1													1	
Cortodera humeralis			1																1	
Cerambycidae indet.									1						4				5	
Chrysomelidae																				
Cassida nebulosa																	1		1	
C. sp.																		2		2
Orsodacne sp.												1								1
Aphthona sp.								1											1	
Chrysomelidae indet.															1				1	
Chrysomelidae larvae																	1		1	
Dermestidae larvae																				
Dermestes sp.													1							1
Dermestidae indet.																	1	2	1	2
Coccinellidae larvae															7			3	7	3
Buprestidae larvae																	1		1	
Oedemeridae																	1	1	1	1
Curculionidae																				
Balaninus glandium			3																3	
Tannymecus palliatus						1													1	
Polydrosas mollis							1		3										4	
Phyllobius sp.			1																1	
Curculionidae indet.	2	2									1				20		4		27	2
Coleoptera indet.	5					3	1	3						1	10	2	9	4	31	7
Coleoptera larvae	1			2		3	1	1						1	6	1	5	1	19	3
Coleoptera p.															4				4	

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
Trichoptera															1				1	
Lepidoptera																				
Hepialidae p.															8				8	
Tineidae																				
Neopogon sp.															1				1	
Coleophoridae larvae											1				1				2	
Gelechiidae																				
Depressaria sp.						1													1	
Gelechiidae indet.						1													1	
Tortricidae			1	1										1					2	1
Tortricidae larvae																				
Tortrix viridana	4					7									6				17	
Pandemis spp.						2													2	
Tortricidae indet.	6	1	3			42						4	4		8	4	1	1	60	14
Tortricidae p.						12										1			12	1
Psychidae larvae															1				1	
Microlepidoptera															1				1	
Arctiidae larvae																				
Callimorpha quadripunctata						1													1	
Arctiidae indet.						1													1	
Notodontidae																				
Drymonia chaonia						2						1	1						2	2
Lophopteryx camelina	1																		1	
Notodontidae larvae																				
Drymonia chaonia				1			2		1				4				1		5	4
Notodontidae p.						2													2	

Noctuidae																				
Orthosia cruda						3						6							3	6
O. stabilis			3												1				4	
O. incerta	3																		3	
O. gothica												1			1				1	1
O. spp.	1		1			4						3			3				9	3
Apatele rumicis			1																1	
Ephesia nymphagoga				1															1	
Xylomania conspicillaris												1								1
Conistra vaccinii			3																3	
C. erythrocephala	1																		1	
C. spp.			2																2	
Noctuidae indet.												1								1
Noctuidae larvae																				
Orthosia cruda	3		29			14							2		11	6			57	8
O. munda													1		1				1	1
O. stabilis						58			3		2		19		22	8			85	27
O. incerta						7													7	
O. miniosa															1				1	
O. spp.		1		1		9			2		1		3		5	12		1	16	17
Conistra vaccinii		3				2	3		2				1		1				8	4
C. erythrocephala				4			1								1				6	
C. spp.			5	1											3	1			9	1
Eupsilia transversa						1			3				1						4	1
Allophyes oxyacanthae			1			1			1				1						3	1
Agrochola litura						20			1		5		8		1				27	8
A. nitida															4				4	
A. helvola															1				1	
A. spp.	3		42			3	1						1		8	1			57	2
Cirrhia sulphurago						1							1						1	1
C. icteritia											1								1	
C. spp.						2							6						2	6
Dicycla sp.			1																1	
Tholera decimalis			6	1															7	
Scotia segetum			1																1	
Scotia spp.	1														1				2	
Mamestra brassicae	1																		1	
M. oleraceae													1							1
M. spp.													2		1				1	2
Amphipyra pyramidea													1							1

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
A. tragopoginis															1				1	
Apamea monoglypha															1				1	
Tholera cespitis															3				3	
Cerastis rubricosa															1				1	
Agrotis spp.															20				20	
Hoplodrina spp.															2	1			2	1
Diloba coeruleocephala																	1		1	
Noctuidae indet.	5		15			9							5		115	12	9	7	153	24
Tetheidae p.				1															1	
Geometridae																				
Alsophila aescularia						1													1	
Theria rupicapraria						1													1	
Geometridae indet.				1											1				2	
Geometridae larvae																				
Colotois pennaria			3	1		32			5			6	13		13	6			54	25
Phygalia pilosaria						2						4	1						2	5
Operophtera brumata			1			54						16	14		37	21			92	51
Erannis defoliaria	1					6							2		8	5			15	7
E. marginalis						1													1	
E. leucopharia															1				1	
E. spp.			8	1		10			1				3	1	5				25	4
Pseudopanthera macularia															1				1	
Boarmia roburaria															1				1	
B. spp.	1		16			19	1		1			16	9		1				39	25
Rhodostrophia vibicaria															1				1	
Lycia hirtaria			11			1							1			1			12	2
Ascotis selenaria						3													3	
Angerona prunaria						3													3	
Tephrina arenacearia						1													1	
Ectropis bistortata						1													1	
Selenia lunaria													2							2
Biston betularia													1							1
Geometridae indet.	6		34		1	32			1			9	11	1	94	14	1	4	168	40

Lycaenidae																				
Thecla quercus															1				1	
Nymphalidae larvae																				
Nymphalis polychloros			1																1	
Nymphalidae indet.																	1		1	
Nymphalidae p.															1				1	
Lepidoptera indet.			3	3		4	4										3		17	
Lepidoptera larvae indet.	8	1	38		1	17			8		1	2	2	1	49	2	5	2	126	11
Lepidoptera p. indet.			13			1									1		1	1	16	1
Diptera																				
Bibionidae																				
Bibio marci															1				1	
B. hortulanus															16		1		17	
Bibio spp.									1						1				2	
Bibionidae indet.	7		11		1	2						11			1				21	12
Tipulidae	12	1	167		1	15	1		1			31			106	2	1		303	35
Tipulidae larvae	2								16						3				21	
Tipulidae p.	1		2			6			14						18	1			41	1
Limoniidae	15		87			28						59			69				199	59
Limoniidae p.															1				1	
Sciaridae															3				3	
Tabanidae																				
Tabanus bromius															1				1	
Stratiomyidae							1	1									2		4	
Asilidae																				
Dialtria flavipes				2															2	
Asilidae indet.			2												1		4		7	
Bombyliidae															2				2	
Empididae															8				8	
Syrphidae																				
Episyrphus balteatus				23												1			23	1
Ferdinandea cuprea															1				1	
Metasyrphus corollae															1				1	

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
Cheilosia sp.															1				1	
Syrphidae indet.	1						2							1			1	1	4	2
Syrphidae larvae															1				1	
Muscidae																		3		3
Calliphoridae																				
Sarcophaga carnaria															2				2	
Calliphoridae indet.													1							1
Tachinidae	1					3									2	1			6	1
Diptera indet.			12	4		10	3		1	31		3		1	7	1	4	1	72	6
Diptera larvae indet.	38	2	1			1		1				1		1	5	1	2		48	5
Diptera p. indet.		1				1													1	1
Hymenoptera																				
Tenthredinidae																				
Dolerus gonager			1																1	
Allanthus mascultus			1																1	
Tenthredinidae indet.	6					2									1			1	9	1
Tenthredinidae larvae							1									1			1	1
Cynipidae															1				1	
Ichneumonidae			1												3				4	
Formicidae																				
Camponotus spp.	3		1			1									6		1		12	
Formicidae indet.			2		1	12	4					2			12		33	4	63	7
Formicidae p.																	65		65	
Vespidae																				
Vespa crabro			1			1		1											3	
Vespidae indet.															3				3	

Apidae	2														2		1		5	
Hymenoptera indet.	4		1	1		6		1				1	1		3	1		1	16	4
Hymenoptera p. indet.			1			1									1				3	
Pseudoscorpioidea															1				1	
Phalangiidea																				
Opilionidae																				
Zacheus crista			1	1		1									4				7	
Opilio saxatile							3							1					3	1
Platybunus bucephalus						5		1				1							6	1
P. spp.			5				1												6	
Lophopilio palpinalis	2																		2	
Egaenus convexus													1	3						4
Opilionidae indet.															17	3	13	1	30	4
Araneidea																				
Atypidae																				
Atypus affinis			1			11							1				4		16	1
Dysderidae																				
Harpactes rubicundus			9			3			1				3		5		1		19	3
Dysdera erythrina			1																1	
Dysderidae indet.									1										1	
Drassidae																				
Drassodes silvestris			1																1	
Clubionidae																				
Clubiona terrestris						1													1	
Thomisidae																				
Philodromus aureolus	1																		1	
Xysticus lanio	1		3			3							2	1					7	3
X. kochi						3							1						3	1
X. erraticus							1												1	
X. cambridgei			2			2	2					1							6	1
X. spp.			1									1	3						1	4
Oxyptila praticola							2						1						2	1
O. atomaria			1																1	
Heriaeus hirtus			2																2	
Thanatus formicinus												1								1
Thomisidae indet.															4	3	2		6	3

	1978		1979			1980									1981		1982		Total	
	B_1	S_1	B_1	B_2	S_1	B_1	B_2	B_3	B_4	B_5	B_6	S_1	S_2	S_6	B_1	S_1	B_2	S_2	B	S
Theridiidae															2				2	
Linyphidae																				
Linyphia clathrata			1			5		1											7	
L. hortensis			1																1	
Linyphidae indet.															1				1	
Agelenidae																				
Tegenaria torpida			1																1	
Coelotes sp.						1													1	
Pisauridae																				
Pisaura mirabilis	1																		1	
Lycosidae																				
Alopecosa trabalis	1		2																3	
A. schulzeri			2			1													3	
A. sp.												1								1
Trochosa terricola			1		1	1		1											3	1
Pardosa lugubris		1				1						1							1	2
P. agrestis									1										1	
Lycosidae indet.															4		4	1	8	1
Dictynidae																				
Titanoeca schineri			1																1	
Araneidea indet.							1	1	1						9	1	9	1	21	2
Araneidea cocoon			2				1												3	
Acaridea							1												1	
Insecta indet.								1							12	2	3	1	16	3
Vertebrata																				
Squamata																				
Anguidae																			1	
Anguis fragilis						1														

Plant foods																				
Rosales																				
Rosaceae																				
Cerasus vulgaris							3					1	1		1	7	2	3	5	12
Malus sylvestris										1									1	
Artificial foods																				
bread										2									2	
meal										1									1	
Total	247	28	770	67	11	768	121	104	98	53	15	220	199	38	1272	167	318	91	3833	754

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