Food Composition of Nestling Blackbirds in an Oak Forest Bordering on an Orchard

By

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Abstract. The author studied the food composition of nestling blackbirds in an oak forest neighbouring upon an orchard with the neck-collar method. The values of the dry weight and calory content of the food taken in, as well as the proportion of these quantities to the unit weight of the nestlings (1 g) showed a positive correlation with the growth of the latter. The four major groups of food were Lepidoptera larvae, Coleoptera adults, Diptera and earthworms. The nestlings consumed food of high and low caloric value in small, that of medium value in large rate.

Introduction

The blackbird is a common breeding species in various habitats, and therefore its ecological valuation is of special importance when revealing the internal connections of the natural and agro-ecosystems. Numerous studies have been published on this species in the ornithological literature so far, among them the works of MORRIS (1954), HARTLEY (1954), SNOW (1956, 1958, 1966), EBLE (1963), KORODI GÁL (1967), DYRCZ (1969), VAUK and WITTING (1971), SMITH (1973), BERTHOLD (1976), as well as HAVLIN (1977) are prominent. SNOW (1956, 1958, 1966) dealt with the species in many respects, and devoted attention to its territorial behaviour and population dynamics. HARTLEY (1954), MORRIS (1954), BERTHOLD (1976), as well as VAUK and WITTING (1974) examined, among others, the food composition of the blackbird. KORODI GÁL (1967) studied the growth of nestling blackbirds in relation to their food and analysed their diet at different ages. HAVLIN's (1977) comparative study rested on an analysis of the stomach contents of several hundred starlings and blackbirds. Using the same method EBLE (1963) investigated the food of blackbird in several habitats. DYRCZ's (1969) comprehensive paper discussed distribution, habitat selection food composition and breeding ecology of the species. SMITH (1973) analysed the food-searching behaviour of blackbirds.

The present study is aimed at setting forth the investigations on the nutrition of nestling blackbirds. Since the purpose of the research has been the ecolo-

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gical examination on the common species breeding in the urban environment and in agricultural areas, I chose the study area in a suburban forest of Budapest bordering on an orchard. The study comprises some preliminary results of a manifold research work planned, in view of the above considerations, to last for several years.

Methods

The dominant tree species of the forest chosen as a study area was *Quercus cerris*, in smaller quantities also *Quercus petrea, Carpinus betulus, Acer campestris* and *Cerasus avium* were growing in it. The edge of the oak forest was covered with dense shrubbery (*Crataegus* spp., *Ligustrum vulgare, Rosa* spp., *Sambucus nigra*). The orchard neighbouring the forest consisted of apple- (Jonathan, Starking, Golden Delicious), apricot-, peach-, cherry-, sour cherry-, pear- and plum-trees.

From April to July of the years 1978 and 1979 the food samples were collected through 26 days from 47 nestlings of 12 nests. If one considers the food taken in by 1 nestling in 1 hour as a unit, i. e. a sample, then 292 samples were analysed in the course of the investigation. There was a compressing band (a cotton thread 3 mm in diameter) round the neck of the nestlings to hinder the swallowing of food placed, loosely enough so as not to strangle them. The method was applied first by KLUJVER (1933), after him among others also ORIANS (1966), KORODI GÁL (1967), DYRCZ (1969) and WALSH (1978) used it in collecting food from various bird species. The food composition of the nestlings from hatching to the time of leaving the nests (11 – 12 days) was followed with this method. The collars were on the nestlings for an hour, then the food accumulated in the meantime was removed by means of tweezers while gently massaging the throat of the nestling. Subsequently to this the neck-collar was taken off and the nestling was fed with boiled eggs of an approximately identical quantity with that taken away. The collar was put up to that time. After one hour's free swallowing the collar was put round the nestling's neck again. Thus, in hourly turns, the food samples could been continuously obtained between 06.00 and 18.00.

After removal, part of the food samples were rinsed by water and placed into a preserving solution composed of: 53% ethyl alcohol (95% alcoholic strength) 33% distilled water, 7% glycerin, 7% glacial acetic acid (concentrated acetic acid). In this solution animals keep their softness and colour even after a longer time.

The other part of the food samples was separated by taxonomic groups, dried at 104 °C to constant weight, then weighed and its caloric value was determined. When calculating the latter, the caloric data published in the literature were also taken into consideration (Table 1). Where there were more than one such data regarding one animal group at my disposal, I averaged the values and used the obtained means in the course of the further calculations.

Results

The weight of the nestlings taken as a function of time increased according to the logistic equation $wt = 54.5/1 + e^{-0.647\,(t-3.896)}$. Since, however, this value concerned the nestlings at times deprived of their food, it may be presumed

*Table 1. Caloric values of the invertebrate animals occurring in the food (cal/g dry weight; * = mean of several measurements)*

Taxon	cal/g dry wt.	Mean
Lumbricidae	4125,6 Blem (1969) 5012,0 Cummis (1971) 5326,3 East (1976) 4671,3 French (1957)	4783,3
Isopoda	3671,5* Reichle (1967) 3942,5* Saito (1969)	3794,5
Diplopoda	3520,0 Reichle (1967) 3377,0* Török	3424,7
Chilopoda	4985,1 Reichle (1967)	4985,1
Phalangida	5362,0 Reichle (1967)	5362,0
Araneidea	5581,9 Moulder (1970) 6399,0* Török	5990,5
Orthoptera	5501,9 Moulder (1970) 5578,1 Edwards (1970) 5418,5* Cummis (1971)	5420,0
Coleoptera	5561,0* Török	5586,2
Elateridae	5439,9* Cummis (1971)	5439,9
Carabidae	5496,1 Edwards (1970) 5043,9* Lővei (unpub. data)	5270,0
Tenebrionidae	5851,8* Englemann (1961)	5851,8
Melolonthidae	5808,5* Török	5808,5
Diptera	5768,0 Cummis (1971)	5768,0
Hymenoptera	6076,8 Edwards (1970) 4548,8 Cummis (1971) 4867,7 Cummis (1971)	5090,3
Formicidae	6076,8 Edwards (1970) 4548,8* Cummis (1971)	5312,8
Apidae	4867,7 Cummis (1971)	4867,7
Hemiptera	5638,0 Wiegert (1965) 7178,0 Mukerji (1969)	6408,0
Cercopidae	5638,0 Wiegert (1965)	5638,0
Blattidae	5397,0* Woodland (1968)	5397,0
Lepidoptera ad.	6532,3* Török	5056,8
Geometridae ad.	4602,0 Bergeron (1970)	4602,0
Noctuidae ad.	6007,0 Bergeron (1970)	6007,0
Tortricidae ad.	3086,0 Bergeron (1970)	3086,0
Lepidoptera larv.	5297,6* Gere (1957) 6517,0 Mukerji (1969) 4271,4* Török	5362,8
Lepidoptera pupa	6635,0* Gere (1957)	6635,0

that it differs from the values of growth of nestlings reared in undisturbed conditions. Value K = 0.647 shows rapid increase. The weight of the nestlings abruptly rose between the ages of two to eight days, before and after this the rate of growth was slower.

The quantity expressed in dry weight of the food taken in in a day (Fig. 1), as well as its caloric value rose in direct proportion with the growth of the nestlings. By means of linear regression analysis, the equations

$$Y_1 = -0.6977+0.0527X \qquad (P < 0.001)$$
$$Y_2 = -3715.37+294.95X \qquad (P < 0.001)$$

express this relationship, with values $r_1 = 0.794$ and $r_2 = 0.775$. (Y_1 = the food taken in: g per day, in dry weight, Y_2 = the quantity of calories taken in: cal per day, X = the weight of the nestlings: g.)

In the food samples collected from the nestlings 80 species could be determined; on account of difficulties of determination part of the animals were separated only into genera, families and orders. I found no plant items at all in some cases however grains of sand, pebbles and snail fragments were found.

33.1% of the total nestling diet consisted of caterpillars (Table 2), besides this, the share of the lepidopterous adults was 2.2%, that of the pupae 0.4 %.

The most important species were those of the genus *Agrochola* and *Orthosia cruda*. In a quantity nearly identical with that of the caterpillars were present the Coleoptera adults (32.7%), out of which *Calosoma inquisitor*, *Melolontha*,

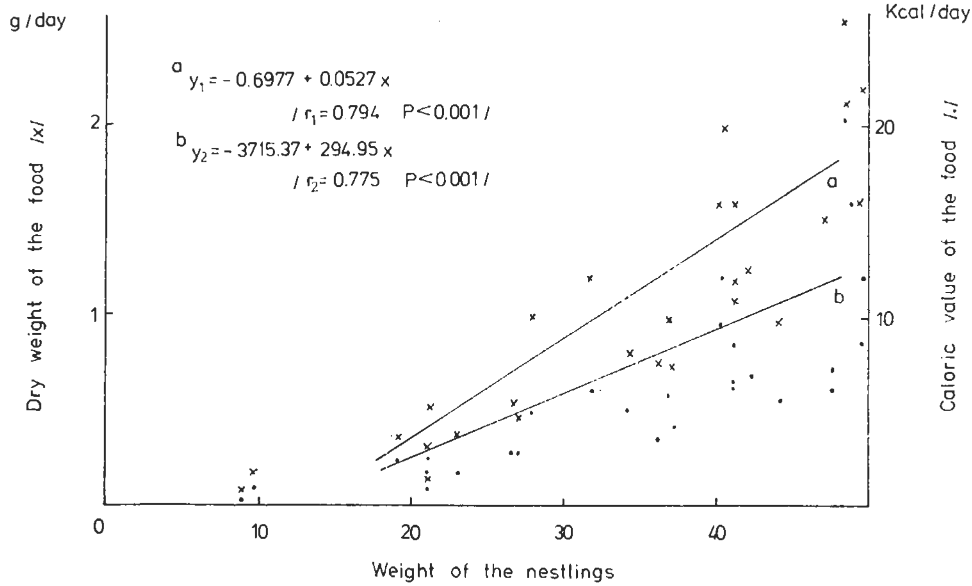

Fig. 1. Relation between the dry weight *(a)*, caloric value *(b)* of the food and the weight of the nestlings

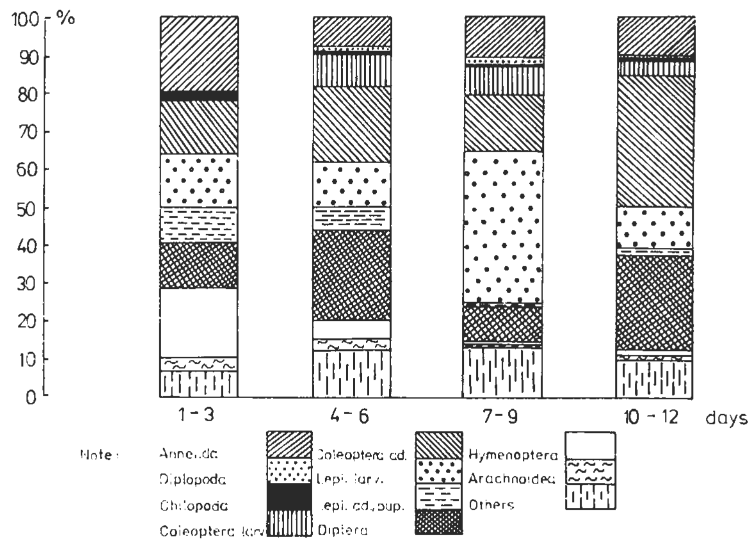

Fig. 2. Percentual distribution of the major groups of food at four stages of the nestlings

Table 2. Food composition of nestling blackbirds in an oak forest
(a — total weight in the 292 samples; b — percentual distribution as compared with the total weight of the 292 samples [29.3329 g]; c — number of the samples in which the prey species could be found; [1 sample = quantity of food consumed by 1 nestling in 1 hour])

Taxon	a g dry wt.	b %	c Number of samples
Annelida			
Lumbricidae			
Dendrobaena octaedra	0.0142		2
Dendrobaena sp.	0.0675		4
Allolobophora caliginosa	0.1636		2
Allolobohora rosea	0.2514	8.05	16
Allolobophora sp.	0.1510		2
Lumbricus sp.	0.0656		4
Lumbricidae indet.	1.6447		91
Mollusca			
Limacidae	0.0050	0.02	1
Arthropoda			
Isopoda			
Protracheoniscus amoenus	0.0351		10
Armadillidium sp.	0.0070	0.21	3
Isopoda indet.	0.0203		5
Diplopoda			
Glomeris hexasticha	0.0708	0.70	5
Chromatoiulus projectus	0.1346		20
Chilopoda			
Monotarsobius austriacus	0.0015		1
Lithobius muticus	0.0361		10
Lithobius forficatus	0.0045	0.18	2
Henia illyrica	0.0046		1
Cryptops sp.	0.0036		2
Blattidea indet.	0.0711	0.24	2
Orthoptera			
Pholidoptera griseoaptera	0.0399	0.14	2
Dermatoptera			
Forficula auricularia	0.0951	0.33	11
Heteroptera			
Pentatomidae			
Palomena prasina	0.0227		2
Miridae indet.	0.0012	0.13	1
Heteroptera indet.	0.0120		6
Neuroptera			
Raphidia flavipes	0.0010	0.01	1
Coleoptera			
Carabidae			
Calosoma inquisitor	4.0406		21
Pterostichus cupreus	0.0433		2
Pterostichus vulgaris	0.0223		1
Pterostichus sp.	0.0200		3
Harpalus rufipes	0.0873	15.65	6
Harpalus smaragdinus	0.0061		2
Harpalus sp.	0.0320		2
Carabidae ad. indet.	0.1278		11
Carabidae larv. indet.	0.2152		18

Taxon	*a* g dry wt.	*b* %	*c* Number of samples
Staphilinidae			
Ocypus olens	0.0700	0.38	4
Xantholinus sp.	0.0026		1
Staphilinidae indet.	0.0355		4
Silphidae			
Xylodrepa quadripunctata	0.6149	2.44	26
Silphidae larv. indet.	0.1004		3
Cerambycidae			
Cortodera humeralis	0.0100	0.04	1
Tenebrionidae			
Cylindronotus aeneus	0.2143	0.73	7
Scarabaeidae			
Onthophagus coenobita	0.1681	0.98	3
Onthophagus verticicornis	0.0800		2
Onthophagus spp.	0.0400		2
Melolonthidae			
Melolontha melolontha	1.5594	7.77	17
Rhizotrogus aequinoctialis	0.4215		10
Amphimallon solstitialis	0.1382		2
Melolonthidae indet.	0.1610		4
Cantharidae			
Cantharis fusca	0.0704	0.39	6
Cantharis obscura	0.0312		2
Metacantharis haemorrhoidalis	0.0048		1
Malachius sp.	0.0072		2
Elateridae			
Athous rufus	0.7148	5.30	28
Prosternon tesselatum	0.1382		11
Adelocera murina	0.0567		4
Melanotus sp.	0.0229		2
Elateridae larv. indet.	0.1313		9
Elateridae ad. indet.	0.4936		21
Curculionidae			
Balaninus glandium	0.0237	0.10	4
Phillobius sp.	0.0060		2
Coleoptera ad. indet.	0.1232	3.00	28
Coleoptera larv. indet.	0.7600		21
Lepidoptera adults			
Tortricidae indet.	0.0722	0.24	2
Notodontidae			
Lophopteryx camelina	0.0996	0.34	4
Noctuidae			
Conistra vaccinii	0.1023	1.26	5
Conistra erythrocephala	0.0284		3
Orthosia stabilis	0.0649		9
Orthosia incerta	0.0381		2
Orthosia spp.	0.0538		6
Apatele rumicis	0.0290		3
Ephesia nymphagoga	0.0500		1
Lepidoptera larvae			
Tortricidae			
Tortrix viridana	0.1000	0.65	3
Tortricidae indet.	0.0905		12

Taxon	*a* g dry wt.	*b* %	*c* Number of samples
Notodontidae			
Drymonia chaonia	0.0900	0.31	2
Geometridae			
Colotois pennaria	0.3771		4
Lycia hirtaria	0.5193		16
Operopthera brumata	0.0179	9.37	2
Erannis spp.	0.3108		19
Boarmia spp.	0.3998		7
Geometridae indet.	1.1285		43
Noctuidae			
Dicycla oo	0.0372		4
Allophyes oxyacanthae	0.1036		4
Tholera decimalis	0.3959		7
Mamestra brassicae	0.0800		3
Conistra erythrocephala	0.2720		3
Conistra spp.	0.2127	20.28	12
Orthosia cruda	1.4502		42
Orthosia spp.	0.1100		2
Scotia segetum	0.3521		2
Scotia sp.	0.0911		3
Agrochola spp.	1.6727		52
Noctuidae indet.	1.1783		39
Nymphalidae			
Nymphalis polychloros	0.0967	0.33	2
Lepidoptera ad. indet.	0.0951	0.33	3
Lepidoptera larv. indet.	0.6103	2.09	59
Lepidoptera pup. indet.	0.1149	0.39	21
Diptera			
Tipulidae			
Tipula livida larv.	0.0416		3
Tipulidae ad. indet.	3.0113	10.65	78
Tipulidae pup. indet.	0.0739		3
Limoniidae			
Limonia pannonica	0.0035		6
Limonia nigripunctata	0.0520	1.12	4
Limoniidae indet.	0.2774		28
Bibionidae indet.	0.0776	0.27	21
Asilidae			
Dialtria flavipennis	0.0150	0.07	2
Asilidae indet.	0.0050		2
Syrphidae			
Epistrophe balteata	0.2234	0.78	1
Syrphidae indet.	0.0052		1
Tachinidae indet.	0.0089	0.03	2
Diptera ad. indet.	0.0734	0.25	22
Diptera larv. indet.	0.4088	1.39	10
Hymenoptera			
Tenthredinidae			
Dolerus gonager	0.0051		2
Allanthus masculatus	0.0230	0.21	2
Tenthredinidae indet.	0.0332		5
Ichneumonidae indet.	0.0017	0.01	1

Taxon	a g dry wt.	b %	c Number of samples
Formicidae			
Camponotus ligniperda	0.1052	0.63	4
Camponotus sp.	0.0693		7
Formicidae indet.	0.0085		3
Vespidae			
Vespa cabro	0.0589	0.20	2
Apidae indet.	0.0290	0.10	4
Hymenoptera ad. indet.	0.0236	0.08	7
Hymenoptera pup. indet.	0.0076	0.03	2
Phalangiidea			
Lophopilio palpinalis	0.0023	0.18	1
Zacheus crista	0.0244		4
Platybunus sp.	0.0197		5
Phalangiidea indet.	0.0051		2
Araneidea			
Atypidae			
Atypus affinis	0.0084	0.03	1
Amaurobiidae			
Titanoeca schineri	0.0009	0.01	1
Dysderidae			
Harpactes rubicundus	0.0492	0.17	15
Dysdera erythrina	0.0019		2
Agelenidae			
Tegeneria torpida	0.0066	0.02	2
Pisauridae			
Pisaura mirabilis	0.0062	0.02	2
Lycosidae			
Alopecosa trabalis	0.0318	0.47	11
Alopecosa schulzeri	0.0851		8
Trochosa terricola	0.0214		2
Linyphidae			
Linyphia hortensis	0.0006	0.01	1
Linyphia clathrata	0.0014		1
Drassidae			
Drassodes silvestris	0.0091	0.03	2
Thomisidae			
Xysticus kochi	0.0109	0.59	2
Xysticus lanio	0.0450		9
Xysticus cambridgei	0.0923		4
Xysticus sp.	0.0050		2
Heriaeus hirtus	0.0150		1
Oxyptila atomaria	0.0030		1
Philodromus aureolus	0.0038		2
Total	*292.3329*	*99.73*	*292*

melolontha, *Xylodrepa quadripunctata* and Elateridae were the dominant ones. The proportion of the Coleoptera larvae was 4.1%. Also Diptera meant a relatively significant group of food with 14.6%, within which Tipulidae and Limoniidae families were conspicuous. Earthworms, one of the characteristic animal food of the blackbird, was present only in 8.1% in the collected material. Hymenoptera, spiders and other taxa were of no significance in the food the nestlings.

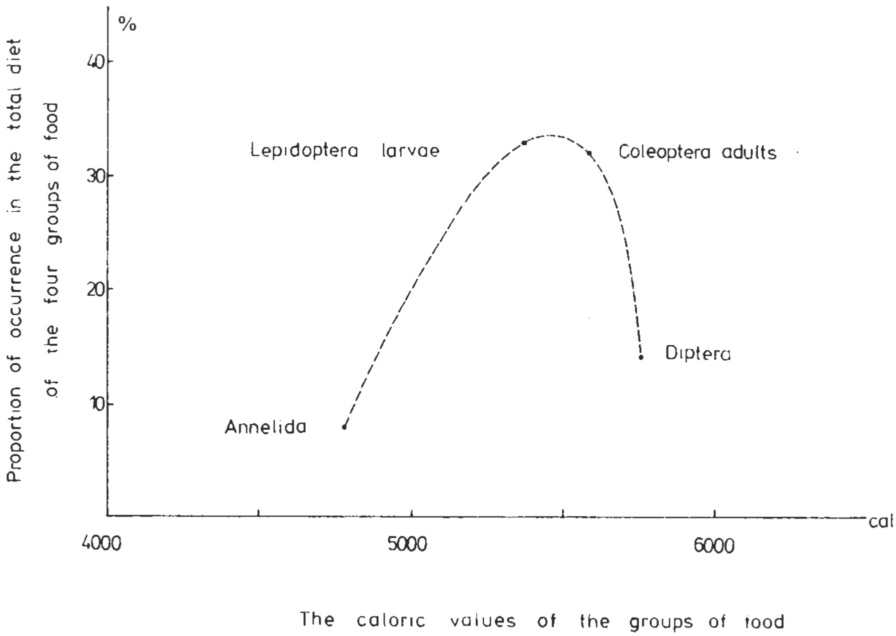

Fig. 3. Frequency distribution of caloric values of major food items in nestling blackbird's diet

With the growth of the nestling blackbirds also the composition of their food was changing (Fig. 2). The 1 – 3 days old nestlings eat mainly softer invertebrates: earthworms, Hymenoptera, spiders. The proportion of Coleoptera was relatively low, but that value increased with the older nestlings. Diplopoda were absolutely lacking from the food at this age of the birds. At a more developed stage of the nestlings the proportion of the adults and pupae of Lepidoptera, Hymenoptera, earthworms and spiders decreased. The occurrence of Diptera and caterpillars did not show an unambiguous tendency.

Relationship can be presented between the caloric value of the prey groups and their rate in nestling diet (Fig. 3). Blackbirds consumed more Coleoptera adults and caterpillars of medium caloric value than earthworms of relatively low and Diptera of high caloric values.

Discussion

Comparing the present results with Vauk and Witting's (1971) investigations on nutrition conducted in the migration period of birds, one evidently finds significant differences. Thus, in the stomach contents analysed by them during the migration period there was 40% of plant food and the caterpillars were missing. Since the diet of the bird species is determined by the food supply of the various areas well as by the seasons, there are differences also within the insect food, if comparing Vauk and Witting's data with the ones presented here. In the material collected by them, the food of the migration blackbirds contained many snails *(Oxychilus* sp., *Littorina)*, weevils *(Otiorrhynchus ovatus)* and ants *(Formica* sp.) which do not occur at all or in insignificant quantities in the samples collected by us.

According to EBLE's (1963) study the rate of plant and animal components in the food of blackbird is 48.7% and 51.3% respectively. (HAVLIN's (1977) data: 10% plant food, 90% animal food) In oak forest neither DYRCZ (1969) nor me found plant components in the food of nestlings. The possible reasons of this difference are: *a)* EBLE studied adult specimens and we worked on nestlings, *b)* the study area chosen by EBLE was not an oak forest.

The fact that the food composition has changed in some measure during the growth of the nestlings, can be ascribed in part to the specific character of the preys. At the age of 1 – 3 days a significant part of the food consist of earthworms and easily digestible insects poor in chitin (Diptera, Hymenoptera, Lepidoptera larvae, pupae and adults). The proportion of Coleoptera rose notably during the latter stages of growth. At that time Diplopoda did appear in the food, but their number remained low. Comparing the above results with data of KORODI GÁL (1967) the increase of the rate of Coleoptera and decrease of that of the spiders can also be stated in both investigations.

With the exception of 1 slug, the food did not contain snails. This can, however, be ascribed in the first place to the lack of snails in the environment, and/or to the circumstance that the dry weather did not help the propagation of the snails. Possibly also the relatively small rate of earthworms in the food finds its explanation in this.

In EBLE's (1963) results Coleoptera was dominant, but the proportion of Gastropoda, Diptera, Lepidoptera was also relatively high. In my examination the same taxa proved to be the main animal groups except Gastropoda. DYRCZ's (1969) data are similar, too, but the proportion of Lepidoptera adults was considerably higher.

The food taken in and its caloric value rose in direct proportion to the weight of the nestlings. Also the dry weight and caloric value of the food falling to the unit weight of the nestlings (1 g) rose with the growth of the latter, although the increase was slight. This change is expressed by the equations

$$Y_1 = 0.004 + 0.001X \qquad r_1 = 0.707 \qquad (P < 0.001)$$
$$Y_2 = 11.01 + 4.302X \qquad r_2 = 0.671 \qquad (P < 0.001)$$

(Y_1 = food, g per day falling to unit nestling wight [1 g], Y_2 = calory intake, cal per day falling to unit nestling weight [1 g], X = weight of the nestling, grams.)

Studying the caloric values of the four main groups of food one finds that the blackbirds have consumed more food items of medium caloric value than of the ones of relatively low and high caloric values. In forming this proportion, several factors may have a share. Thus e. g. the proportions could be influenced by the frequency of the prey in the areas where the food was acquired, and by the amount of energy expended to finding them. They could be affected, further, by the assimilation value of the food, e. g. by the rate of indigestible chitin in it. In the present investigation I did not separate the latter from the easily digestible food materials, and used uniform values of dry weight and calories in the calculations.

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Summary

The food composition of nestling blackbirds was studied with the neck-collar method in a suburban oak forest of Budapest bordering on an orchard.

The dry weight ($Y_1 = -0.6977 + 0.0527X$) and caloric value ($Y_2 = -3715.37 + 294.95X$) of the food taken in showed a positive correlation with the growth of the nestlings.

The distribution of the ten major food groups was as follows: caterpillars 33.1%, Coleoptera adults 32.7%, Diptera 14.6%, earthworms 8.1%, Coleoptera larvae 4.1%, Lepidoptera adults and pupae 2.5%, Araneida and Phalangida 1.5%, Hymenoptera 1.3%, Diplopoda 0.7%, Chilopoda 0.2%, others 1.1%.

With the development of the nestlings the proportion of the earthworms and Hymenoptera decreased and that of Coleoptera rose in the food.

As regards the caloric values of the various animal groups, as well as the proportion of their occurence in the food, the nestlings consumed beetles and caterpillars of medium caloric value in greatest rates, smaller amounts were ingested of the groups of low and high caloric value.

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