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EKOLOGIA POLSKA - SERIA A

Tom XVII

Warszawa 1969

Nr 16

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DEPARTMENT OF AGROECOLOGY, POLISH ACADEMY OF SCIENCES, TUREW

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COMPOSITION OF FOOD OF THE STARLING,  
*STURNUS VULGARIS* L., IN AGROCENOSES

It has been found that the starling, *Sturnus vulgaris* L., finds 93% of its food on open ground covered by a low vegetation. 80% of the prey are edaphic and epigeous forms, phytophagous and polyphagous and, in some periods, also coprophagous forms being the most abundant among them; they are either the dominant species or those occurring in groups. During its emergence in the spring the Colorado beetle population is being strongly reduced by the starling. The amount of vegetation eaten by the starling in the agrocenoses is of no economic importance.

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The purpose of the present study was to determine the food composition of the starling in a yearly cycle, and to estimate the role of this bird species in the agrocenoses.

Starling is a common and abundant species, easy to introduce to all kinds of afforestation by putting up nest boxes, its feeding niche being in most cases open ground covered with low vegetation. It is, therefore, one of the bird species that may play a particularly important role in the control of pests in cropfields by biological methods. The relatively large body size of this bird is important too, because related to it is a considerable demand for food. For the most part of the year starlings occur in flocks, which are sometimes huge, and are found to feed particularly readily in those areas where insects occur in masses (Kerzina 1949, Sokołowski 1949, Budničenko 1955, Noll 1958, Weinzierl 1961).

In spite of the extensive literature concerned with this subject the role of the starling in the given biocenoses, and its economic importance is still disputable. The composition of its food depends not only on the geographical region with its specific fauna, but also upon the farming activity of man and the duration and nature of the seasons during which starling occurs there.

## 1. STUDY AREA, METHODS, MATERIAL

This paper is based on the material collected in the years 1965 and 1966 in areas near Turew, Kościan district. The material consisted of the contents of the stomachs of shot adult birds and of samples of the food supplied by the adult birds to their nestlings. In addition, an observation was carried out on the biology of breeding and on the abundance and distribution of the starling.

The area under study is typically agricultural and its characteristic feature is a large number of mid-field afforestations in the form of clumps and belts. The wooded areas are not large, each comprising less than 100 hectares. The meadows, spreading along the streams and covering a fairly large proportion of the land, are usually damp.

In the area considered, the starlings appear about February 20, at first in flocks and then in pairs. Eggs for the first brood are laid after 20th April and at the end of May the young leave their nests. In June some starlings prepare for the second brood, whereas the last young leave their nests early in July. After the beginning of June starling flocks are composed of young birds and those old ones which do not repeat breeding. Starlings occur in flocks throughout summer and at the beginning of autumn, until the end of September – first days of October, when they fly away to their wintering regions. They are never found in the country late in the autumn or in winter.

The material was collected:

1. In the park, about 20 ha, surrounding the buildings of the Department of Agroecology at Turew, where a mixed wood grows with broad-leaved trees predominating in it and with a fairly thick undergrowth. The area is damp. The park is intersected by a stream and there are also 3 ponds in it. Lawns represent a large proportion of the ground; about 1.5 ha is used for growing vegetables. On two sides the park borders on the village of Turew and the buildings of the State Farm Turew, and on the remaining two sides – on meadows and arable lands.

2. In a mid-field wood belt, about 1800 m long and 36 m broad, consisting mainly of the locust (*Robinia pseudacacia* L.), the oak (*Quercus robur* L.), the larch (*Larix decidua* Mill.), with the elder (*Sambucus nigra* L.) in the undergrowth. The samples were collected in an area about 1000 m from a rivulet with large damp meadows on either side.

3. In a mid-field clump, about 2 ha, where a mixed wood grows dominated by broad-leaved trees and with a shrub undergrowth. The afforested area is surrounded by large areas of farmland.

In addition to the above areas, the shooting of birds to be used for the investigation was carried out in the fields, meadows and grazing land around the village Turew.

For the analysis of the food composition of the adult birds the contents of the stomachs of the shot down individuals was used. The shooting down of the specimens was usually performed early in the morning or late in the afternoon. Stomach contents were kept in 70% alcohol. The total number of stomachs collected and the number of prey specimens found in them are shown in Table I.

Total number of stomachs collected and of animal and plant specimens found in them

Tab. I

Number of stomachs and of prey	Month								Total
	F	M	A	M	J	J	A	S	
Number of stomachs	5	9	13	8	8	10	27	5	85
Number of animals found	115	503	731	202	226	723	730	116	3,346
Number of plant parts	100	4	5		1	33	434	30	607

The food of the nestlings in the nests was obtained by using the collar method (Kluijver 1933), but instead of the wire or metal-band rings, often recommended, collars made of a thin (about 0.5 mm thick) cord were used. These proved to be much more practical: easier to put on and take off, as has already been reported by Kadočnikov and Malčevskij (1953). The food collected,

most often in the form of balls glued up with large amounts of saliva, was placed in 70% alcohol. Due to the coagulation that followed, the saliva, as well as the mud could be removed from the food samples. After its identification the material was dried at room temperature and then at 65–70°C for 24 hours and weighed on the analytical weighing machine. This procedure made it possible to determine the percentage of the given species or group in relation to the dry mass and in relation to the number of collected specimens of prey. When we deal with material derived from the stomach it is possible only the second way.

In Table II are shown the total number of samples and the number of prey specimens contained in the food collected from the nestlings. The adopted size of samples was the amount of food brought for one nestling during an hour. Food was collected from nestlings varying in their age.

Total number of nestling food samples and of prey specimens collected

Tab. II

Number of samples and of prey	I brood	II brood	Total
Number of samples	558	141	699
Number of animals	2,806	758	3,564
Number of plant parts	—	8	8

## 2. RESULTS

Five different vegetable constituents were found in the food samples (Tab. III): green parts of plants (young plants of winter grains), cereal kernels, field weed seeds, juicy fruits of cultivated plants (cherries) and of wild plants. The division into cultivated and wild plants is artificial, because it does not take into account any possible differences with regard to the interests of the starling. It seems, however, purposeful to make this distinction on account of the fact that the economic importance of the starling depends on what kind of food it eats. In February it feeds mainly on vegetable food consisting of grain seeds, stems of young grain plants. The contents of some stomachs were all vegetable. It should be noted, however, that in some stomachs there was no plant food. Vegetable food (grain kernels) becomes sporadic already in March being then found in small amounts. It occurs again in the June food samples (cherries) from both the young and the adult birds. In July, August and September vegetable food occurs in larger amounts in the stomach contents and in some stomachs only vegetable food is found. At that time the starlings feed on cherries, wild shrub cherries (the elder), grain kernels and field weed seeds. The most frequent amongst the latter are forget-me-nots.

## Percentage of stomachs containing plant parts

Tab. III

Kind of food	Species eaten	Month							
		F	M	A	M	J	J	A	S
Seed of grains	<i>Hordeum distichon</i> L.	60						7	
	<i>Triticum vulgare</i> Vill.	60	11					18	20
	<i>Avena sativa</i> L.	60							
	<i>Secale cereale</i> L.	60							
Wild seeds	<i>Myosotis</i> sp.			7			20	37	40
	<i>Viola</i> sp.						10		
	<i>Chenopodium album</i> L.						20	3	
	<i>Lamium</i> sp.							7	
Cultivated fruits	<i>Cerasus avium</i> (L.) Moench.					12	70	14	
Wild fruits	<i>Sambucus nigra</i> L.						3		
Plant material		20							

The animal part of the food consisted exclusively of invertebrates (except for one tail of the lizard, *Lacerta agilis* L., which the parent birds had brought for their young, this was not considered in the study), mostly insects (Tab. IV and V). As the food of the adult birds and that of the young were collected by different methods and as these two differed somewhat from one another, they are presented separately. In May the results obtained from stomach analysis differed from those obtained from the analysis of the food collected from the nestlings of the first brood (Tab. IV). This was partly due to the gathering of the material at different times: while the shooting down of the birds was performed exclusively in the first half, the nestling food was collected exclusively in the second half of the month. The difference between the results reflects changes in the species composition and quantitative relations of the insect fauna. The above explanation cannot be applied to the difference between the contents of the stomachs collected in June and the food eaten by the nestlings of the second brood, because the material was in both cases collected at about the same time. Certain causes of these differences can, however, be given.

1. Different feeding grounds. During June starling flocks usually keep close to riverside scrubs and feed in the meadows and the nearby fields. Individuals gathering food for their young may seek it in different areas.

2. In its composition the food of the nestlings appears to differ from that of

Group of animals	Month															
	F		M		A		M		J		J		A		S	
	N*	%**	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>Coleoptera</i>	97	84.3	205	40.7	181	24.7	72	35.6	166	73.4	170	23.5	493	67.5	61	52.5
<i>Staphylinidae</i>	1	0.8	14	2.7	4	0.5	2	0.9	3	1.2	14	1.9	54	7.3	11	9.4
<i>Philonthus</i> sp.			8	1.5	1	0.1	1	0.4	2	0.8	10	1.3	50	6.8	11	9.4
<i>Coccinellidae</i>			18	3.5	1	0.1			1	0.4	2	0.2	4	0.5	1	0.8
<i>Silphidae</i>					1	0.1			1	0.4						
<i>Carabidae</i>	17	14.7	46	9.1	23	3.1	18	8.9	10	4.4	25	3.4	102	13.9	36	31.0
<i>Amara</i> sp.	14	12.1	16	3.1	14	1.9	8	3.9	3	1.2	11	1.5	45	6.1	15	12.9
<i>Calathus</i> sp.							5	2.4			3	0.4	41	5.6	15	12.9
<i>Bembidion</i> sp.	3	2.6	27	5.3	3	0.4			1	0.1	1	0.1	1	0.1	3	2.5
<i>Scarabeidae</i>	2	1.7	1	0.1	13	1.7	17	8.4	100	44.2	107	14.8	228	31.2	1	0.8
<i>Aphodius</i> sp.	1	0.8	1	0.1	13	1.7	2	0.9	4	1.7	97	13.4	218	29.8	1	0.8
<i>Phyllopertha horticola</i> L.									96	42.4	9	1.2	7	0.9		
<i>Amphimallon solstitialis</i> L.							15	7.4					3	0.4		
<i>Elateridae</i>			1	0.1	12	1.6	21	10.3					2	0.2		
<i>Agriotes</i> sp.					12	1.6	14	6.9								
<i>Corymbites</i> sp.			1	0.1			6	2.9								
<i>Curculionidae</i>	74	64.3	115	22.3	91	12.4	12	5.9	6	2.6	16	2.2	90	12.3	12	10.3
<i>Sitona</i> sp.	28	24.3	44	8.7	45	6.1	1	0.4			4	0.5	38	5.2	4	3.4
<i>Trachyploeus</i> sp.	5	4.3	29	5.7	11	1.5	2	0.9	1	0.4	10	1.3	7	0.9		
<i>Chrysomelidae</i>			4	0.7	7	0.9			37	16.3	2	0.2	7	0.9		
<i>Leprinetarsa decemlineata</i> Say			1	0.1	2	0.2			34	15.0	1	0.1				
<i>Cantharidae</i>					1	0.1			2	0.8						

<i>Byrrhidae</i>					4	0.5										
<i>Tenebrionidae</i>	1	0.8	1	0.1	12	1.6	1	0.4	2	0.8						
<i>Dytiscidae</i>			3	0.5	6	0.8							1	0.1		
<i>Hydrophilidae</i>			2	0.3	2	0.2					3	0.4	2	0.2		
<i>Dryopidae</i>					5	0.6	1	0.4					2	0.2		
<i>Histeridae</i>											1	0.1				
<i>Lepidoptera</i>	1	0.8					77	38.1	2	0.8	3	0.4	26	3.5	33	28.4
<i>Noctuidae</i>							70	34.6					6	0.8	33	28.4
<i>Diptera</i>	2	1.7	166	33.0	498	68.1	43	21.2	16	7.0	42	5.8	16	2.1	6	5.0
<i>Tipulidae</i>	2	1.7	130	25.8	484	66.2	28	13.3	14	6.1	36	4.9	5	0.6		
<i>Stratiomyidae</i>			22	4.3			5	2.4			1	0.1				
<i>Tabanidae</i>			1	0.1	3	0.4	1	0.4			1	0.1				
<i>Rhagionidae</i>			6	1.1	2	0.2	1	0.4	1	0.4						
<i>Tendipedidae</i>			5	0.9												
<i>Empididae</i>					2	0.2										
<i>Anthomyidae</i>					1	0.1										
<i>Sepsidae</i>													2	0.2		
<i>Opomyzidae</i>													2	0.2		
<i>Syrphidae</i>															6	5.0
<i>Hymenoptera</i>			45	8.9	10	1.3			41	18.1	487	67.3	174	23.8	12	10.3
<i>Ichneumonidae</i>			1	0.1												
<i>Apidae</i>											1	0.1				
<i>Formicidae</i>			44	8.8	10	1.3			41	18.1	486	67.2	174	23.8	12	10.3
<i>Rhynchota</i>											1	0.1	5	0.6	1	0.8
<i>Pentatomidae</i>											1	0.1	5	0.6	1	0.8
<i>Orthoptera</i>											2	0.2				
<i>Araneida</i>	11	9.5	14	2.7	8	1.0	4	1.9	1	0.4	6	0.8	8	1.0	3	2.5
<i>Phalangiida</i>													3	0.4		
<i>Diplopoda</i>					6	0.8	4	1.9								
<i>Chilopoda</i>							1	0.4								

Tab. IV (con.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>Oligochaeta</i>													1	0.1		
<i>Gastropoda</i>	4	3.4	73	14.5	28	3.8	1	0.4			12	1.6	4	0.5		
<i>Cochlicopidae</i>	3	2.6			5	0.6	1	0.4			2	0.2	1	0.1		
<i>Vertiginidae</i>	1	0.8	68	13.5							10	1.3	3	0.4		
<i>Bradybenidae</i>			4	0.7	3	0.4										
<i>Helicidae</i>			1	0.1	11	1.5										
<i>Zonitidae</i>					7	0.9										
<i>Succineidae</i>					1	0.1										
<i>Vitrinidae</i>					1	0.1										

\* Total number of animals of the given group.

\*\* Percentage of the total number of specimens of the given month.

the adult birds. This difference has been observed in a number of forest bird species by Korol'kova (1963), who regarded it to be an adaptive feature permitting a more efficient use of the food supplies. These differences appear not to be a rule and they do not apply to all bird species (Ejgelis 1961).

3. The difference may result from the fact that during the examining of the food of the nestlings and that of the adult birds different methods are used. Food gathered by the collar method is almost undamaged. Regardless of the hardness and hardness of their covers the prey specimens are recognizable and usually identifiable so the material obtained in this way is fully representative, whereas the animal bodies found in the stomachs are more damaged. The condition of the material depends not only on the resistance of the tissues to the action of the gastric juice, but also on its resistance to crushing and grinding, as well as on how long it has been in the stomach. Consequently, it is difficult to identify the small fragments of animals, in extreme cases these are not identifiable. On the other hand, food remains in the stomach for periods varying in length, depending on the kind of food - soft parts remain there for a shorter time than the hard ones. Therefore the results of the analysis of the stomach contents give a distorted picture of the reality. The proportion of prey with hard covers (first of all imagines of *Coleoptera*) found in the stomach

Food of nestlings. (Percentage values below 0.1 have not been taken into account.)

Tab. V

Groups of animals	I brood		II brood	
	N*	%**	N	%
1	2	3	4	5
<i>Coleoptera</i>	756	53.3	200	27.3
<i>Staphylinidae</i>	10	0.2	6	0.6
<i>Coccinellidae</i>	4		1	
<i>Sylphidae</i>	6	0.3		
<i>Carabidae</i>	179	4.6	30	3.4
<i>Pterostichus vulgaris</i> L.	30	0.8		
<i>Pseudophonus pubescens</i> Müll.	25	1.1	10	2.2
<i>Amara aenea</i> Degeer	24	0.2		
<i>Calathus fuscipes</i> Groeze	28	0.1		
<i>Scarabeidae</i>	183	34.4	65	8.2
<i>Melolontha melolontha</i> L.	85	21.8		
<i>Melolontha melolontha</i> – larvae	18	3.6	4	2.1
<i>Amphimallon solstitialis</i> L. – larvae	67	8.6		
<i>Phyllopertha horticola</i> L.	1	0.2	40	4.4
<i>Hoplia graminicola</i> F.	2		14	0.9
<i>Hoplia philanthus</i> Füssl.			5	0.6
<i>Elateridae</i> – imagines	86	2.0	3	0.2
<i>Elateridae</i> – larvae	34	2.0	16	1.7
<i>Agriotes</i> sp.	25	0.2	11	0.9
<i>Corymbites sjællandicus</i> Müll.	60	2.7		
<i>Curculionidae</i>	57	0.8	21	4.0
<i>Chrysomelidae</i>	144	9.5	10	2.5
<i>Leptinotarsa decemlineata</i> Say	126	9.4	8	2.0
<i>Melyridae</i>	1			
<i>Lagriidae</i>	1			
<i>Cantharidae</i>	42	0.6	38	4.3
<i>Cantharis</i> sp.	42	0.6	38	4.3
<i>Byrrhidae</i>	6			
<i>Tenebrionidae</i>	2			
<i>Dytiscidae</i>	1		10	3.6
<i>Lepidoptera</i>	325	6.0	133	40.6
<i>Noctuidae</i> – larvae	318	5.8	86	25.2
<i>Geometridae</i> – larvae	2			
<i>Lymantriidae</i> – larvae			14	3.0
<i>Nymphalidae</i> – larvae			14	6.5
<i>Sathyridae</i> – larvae			1	0.3
<i>Lasiocampidae</i> – larvae			1	1.3
<i>Diptera</i>	1,471	23.5	92	18.3
<i>Tipulidae</i>	382	13.9	32	10.1
<i>Tipula</i> sp. – larvae	369	13.6	31	10.0

Tab. V (con.)

1	2	3	4	5
<i>Tabanidae</i>	29	0.7	1	0.1
<i>Bibionidae</i>	958	8.0	2	
<i>Biblio marci</i> L.	958	8.0	.	
<i>Calliphoridae</i>	12			
<i>Sarcophagidae</i>	18	0.2		
<i>Syrphidae</i>	7		41	2.8
<i>Eristalis tenax</i> L. — larvae			29	2.2
<i>Asilidae</i>	3		1	0.1
<i>Rhagionidae</i>	2			
<i>Therevidae</i>	1			
<i>Anthomyidae</i>	13			
<i>Stratiomyidae</i>	8	0.2	12	4.9
<i>Stratiomys</i> sp. — larvae	2	0.1	10	4.8
<i>Tachinidae</i>	2		1	
<i>Larvevoridae</i>	11		1	
<i>Scatophagidae</i>	2			
<i>Limnobiidae</i>	1			
<i>Muscidae</i>	1			
<i>Hymenoptera</i>	25	0.1	20	1.4
<i>Tentredinidae</i>	5		12	1.3
<i>Ichneumonidae</i>	14		1	
<i>Formicidae</i>	6		2	
<i>Cepidae</i>			5	
<i>Rhynchota</i>	33	0.4	246	1.0
<i>Notonectidae</i>	1			
<i>Myridae</i>	12			
<i>Lygeidae</i>	3			
<i>Nabidae</i>	3			
<i>Coreidae</i>	3		1	0.1
<i>Soutellaridae</i>	4	0.1		
<i>Pentatomidae</i>	7	0.1	3	0.2
<i>Cicadellidae</i>			2	
<i>Aphidoidea</i>			240	0.7
<i>Orthoptera</i>	3			
<i>Tetrigidae</i>	2			
<i>Gryllotalpidae</i>	1			
<i>Odonata</i>	1		1	
<i>Libellulidae</i>	1			
<i>Coenagrionidae</i>			1	
<i>Trichoptera</i>	1			
<i>Neuroptera</i>	3		6	0.1
<i>Chrysopisae</i>			6	0.1
<i>Raphidiidae</i>	3			

Tab. V (con.)

1	2	3	4	5
<i>Araneida</i>	48	0.7	30	0.8
<i>Phalangiida</i>			5	0.2
<i>Diplopoda</i>	6	0.3	3	0.7
<i>Oligocheta</i>	105	14.7	18	9.0
<i>Lumbricidae</i>	105	14.7	18	9.0
<i>Gastropoda</i>	27	0.3	4	0.2
<i>Cochlicopidae</i>	4		2	
<i>Vertiginidae</i>	4			
<i>Bradybenidae</i>	1			
<i>Helicidae</i>	13		1	0.1
<i>Zonitidae</i>	1			
<i>Succineidae</i>	3			
<i>Lymneidae</i>	1			
<i>Planorbidae</i>			1	

\* Total number of animals of the given group.

\*\* Percentage of total dry weight.

contents is too high as compared with the number of prey with delicate soft body covers. In extreme cases, the last named kind of food may appear to be absent. This concerns small and delicate insects such as for instance aphids, larvae of coprophagous beetles which are never found in the stomachs (although the imagines of this group occur in large numbers), larvae (absent) and imagines (in small numbers) of coprophagous *Diptera*, and finally the earthworms — only one specimen was found during the whole investigation, in spite of their being one of the dominant food groups of the nestlings of both the first and the second broods. Of the insect larvae living in the soil (*Coleoptera*, *Diptera*, *Lepidoptera*) only the body covers persist. It seems therefore that as regards the prey which are equally abundant throughout the year their proportion in the adult bird food should be estimated from their percentage in the food obtained from the nestlings. This is particularly true of the earthworms, whose number in the food of the young depends on the weather; it increases during and after rain [the same has been reported by Kluijver (1933)], because the earthworms crawl on the surface. They are no doubt caught and eaten by the adult birds to a much larger extent than would appear from the analysis of the stomach contents, the more so that at the time when earthworms appear on the surface during rain the activity of insects decreases. The percentage of the earthworms in the food will be larger in wet years than in dry years, but the right estimation of this quantity is the values obtained for the nestlings, i.e., 10–15%.

The composition of the food of the nestlings of the first brood differs quite considerably from that of the second brood. It will be as well to consider more closely the quantitative changes, omitting the apparent qualitative changes associated with the dynamics of the insect fauna. In nestlings of the first brood 76.1% of the food is represented by 6 abundant species (or groups), each of which represents no less than 8% of the total amount of food – *Melolontha melolontha* L., *Amphimallon solstitialis* L., *Leptinotarsa decemlineata* Say, *Bibio marci* L., *Tipula* sp. (larvae) and *Lumbricidae*. There are only three such dominant food groups in the second brood, constituting 44.2% of the food – *Noctuidae* (larvae), *Tipula* sp. (larvae) and *Lumbricidae*, thus the proportion and importance of the remaining abundant species and groups increase. Simultaneously, there occur large numbers of those species which are absent or rare during the first brood. These include arboreal (larvae of *Lepidoptera*) and aquatic insects (larvae of *Dytiscidae*, larvae of *Eristalis tenax* L.) or small insects living on herbaceous plants, such as aphids and the aphidophagous species collected with them – larvae of *Syrphidae* and *Chrysopidae*. The widening of the feeding niche and the change of the feeding to a more polyphagous type is accompanied by a change in the size and number of the prey brought by the adult birds for their young. During the first brood the average number of animals per a food sample (food brought for one nestling during one hour) was 5.029 with a total weight of 0.174 g, while in the second brood the respective values were 5.376 animals and 0.125 g. This decrement in the animal food had not been compensated for by a vegetable food – cherries, which occurred in the material considered in very small quantities. This indicates that for the gathering of the same amount of food and thereby for the bringing up of one nestling the adult birds need now more energy. The prey are smaller and more dispersed, which leads on to the widening of the feeding niche, since the birds seek for larger concentrations of prey. It may be presumed that in certain biocenotic systems the amount of energy needed for the bringing up is so large that the adult birds are not able to supply enough food for their young. Maybe that this is the cause of the high mortality among the second brood nestlings, recorded for Turew, this death rate being much higher than that among the first brood nestlings.

### 3. DISCUSSION ON RESULTS

#### 3.1. Plant food

It is rather difficult to determine the percentage of plant parts in the food samples. Using a volumetric method Havlin and Folk (1965) have found that in Czechoslovakia these constitute about 50% of the total amount of food,

plant parts being found only in the food of the second brood nestlings and representing there 38% of the total amount of food. In New York State Lindsey (1939) found a somewhat smaller percentage of plant parts, only 41.4% and as little as 4.9% in the nestling food. Eble (1963) found that in Wittenberg the percentage of plant food, estimated as an average for the whole year, was 23%, the highest values being recorded for June (61.7%), July (47.2%) and September (47.2%). The data reported by Eble (1963) seem to be most reliable. His studies were based on an ample material collected for three years, and there is a considerable consistency between the values calculated for each year separately. Lindsey (1939) and Havlin and Folk (1965) most probably overestimated the percentage of plant parts in the food. This may be explained on the one hand by the nature of the material which was not fully representative because it came from birds shot down in environments of preferential choice [Haberkorn (1962) found that the food from starlings shot down in cherry orchards was in 70% vegetable, while in the food from individuals shot in the neighbouring meadows plant parts represented only 42%]. On the other hand, this may result from the error of method. As has been mentioned, in the stomach the animal material is broken up into very small fragments; the hard parts of the food are retained in the stomach for a longer time, while all the tissue fluids, which represent a large proportion of the body of an insect, pass very quickly to the next sections of the alimentary system. Plant parts remain whole for a longer time, so the results from a volumetric determination of these two kinds of food, found in the stomach, give a somewhat false picture in which the percentage of the plant parts is exaggerated.

During the ripening of cherries starlings certainly cause a serious damage to the orchards (Bruns 1957, Löhr 1957, Haberkorn 1962, Havlin and Folk 1965), although some authors think that the damage is usually exaggerated (Sziij 1957). Łacki (1960) found that at Turew the average amount of cherries eaten by the young starlings of the second brood was 0.25 kg per a nest. Sziij (1957) and Havlin and Folk (1965) reported damage in vineyards, caused by starlings.

Kalmbach and Gabrielson (1921), Mel'ničenko (1949), Budničenko (1955), Sziij (1957), Mansfeld (1958), Havlin and Folk (1965) have written about starlings feeding on grain seeds. They all are of the opinion, however, that grain seeds are only a substitutional food taken at times when there is no other food available, and their being eaten by the starlings is of no economic importance.

For the evaluation of the economic effect it is obviously even more important to know how the birds obtain the grain seeds. Starlings cause damage to the crops only when they peck the kernels out of the ears of a standing corn, or when they peck the sown

seeds from the soil. Collinge (1919/1924) reported injuries to germinating grains, done by the starlings. This observed also Szijj (1957); he pointed out, however, that the damage was not great. Usually, starlings do not peck grain seeds out of the ears. An exception in this respect may be maize (Szijj 1957). In his paper Mansfield (1958) mentioned starlings as pecking grain seeds out of the ears in wheat cocks, or oat swaths, but this feeding habit has been observed very rarely and with the ever-widening full-mechanized harvesting it becomes impossible. Gathering of grain from stubble fields is no doubt useful for it helps to control weeds in the cropfields.

The feeding of the starling on field weed seeds is undesirable because connected with it is the dissemination of the weeds: the starling never breaks up small hard seeds before swallowing them, and these also seem not to be ground in its stomach, so they most probably escape digestion and their ability to germinate is not lost. On the other hand, the eating of the berries of wild shrubs and the subsequent dissemination of their seeds, also not affected by digestion, is a most desirable activity.

We may therefore admit that regardless of the quantities of the plant food eaten by it, this varying with the habitats and seasons the starling causes damage to man's economy only when it feeds in orchards and vineyards. In purely agricultural regions the losses of this kind due to the activity of the starlings are of minor importance, while their feeding on other kinds of food is an unimportant or even advantageous activity. Measures to prevent damage in orchards include scaring the birds away or controlling their numbers. Reduction of the starling population in limited areas, by destroying the nest-boxes in orchard regions is only a half measure, because, as was reported by Haberkorn (1962) from the vicinity of Hamburg, after the breeding season is over large flocks of starlings fly over from distant areas to find food in cherry orchards. Havlin and Folk (1965) think therefore that the only efficient measure is the control of numbers over very large areas. It would be hard to accept this view, as there is no such organism in nature that would not develop activities other than those useful only to man and logically, this can hardly be expected. If we want to organize biocenoses and control the processes that are going on in them, we must accept this fact and find measures other than elimination, to prevent the harmful activity of the otherwise useful organisms. As regards to birds there is an effective means of scaring them away by the specific sounds played from a tape recorder (Vilks 1964; *ibid.* an extensive review of the literature on this subject), and it seems that this method will make it possible to prevent damage by starlings to fruit plantations.

## 3.2. Animal food

### 3.2.1. General

Although the starling sometimes eats considerable amounts of plant parts, its basic food is animal. The percentage of animal food varies with the months, depending on the number of available prey; the composition of the food also varies and it depends on the general natural conditions in the given area. In areas where damp meadows and pastures predominated Kluijver (1933) found that the nestling food contained 40% of *Diptera*, 25% of *Coleoptera*, 13% of *Lepidoptera*; a higher percentage of *Diptera*, 81% of the food was the larvae of *Tipulidae*, was reported by Dunnet (1955). For an orchard Korodi (1962) reported 81% of *Coleoptera*. According to the data of the present research (Tab. V) *Coleoptera* constituted (in the first and second broods, respectively)

53% and 27%, *Lepidoptera* 6% and 40%, *Diptera* 23% and 18%. In Korol'kova's (1963) study *Lepidoptera* larvae are reported to constitute 82% of the food in steppe oak woods. Similar variations can also be seen in the food of the adult birds.

### 3.2.2. Percentage of biological groups

As mentioned above, the food of the starling varies considerably. Depending on a number of factors, the percentage of the particular taxonomic groups may be larger or smaller. The individual taxonomic groups include animals differing in their biology and belonging to different trophic levels. It seems therefore that the animals on which the starlings feed should at first be divided into biological groups. A closer investigation of the percentage of these groups in the food of the starling will permit a more accurate description of the role of this bird species in the biocenosis. In the agrocenoses (Tab. VI) most of the food is phytophagous insects: *Coleoptera* – 31.2% (mainly *Curculionidae*, *Scarabaeidae*, *Elateridae*), *Diptera* – 45.6% (*Tipulidae*, *Bibionidae*), *Lepidoptera* – 13.2% (mostly larvae, chiefly *Noctuidae* larvae), other taxonomic groups constituting as little as 9.4%. Polyphagous groups were found to occur in the following percentages: *Coleoptera* (*Carabidae*) 17.1%, *Hymenoptera* (*Formicidae*) 76.3%, *Diptera* 5.4% and other groups 1.1%. Zoophagous groups were: *Coleoptera* (*Carabidae*, *Staphylinidae*, *Coccinellidae*) 63.5%, *Diptera* 12% and other groups 22.4%. *Coleoptera*, mainly the representatives of the genus *Aphodius*, caught in the grazing grounds, constituted 98.8% of the coprophagous group. *Diptera* represented as little as 1.2% – this value is perhaps too low because the larvae of the coprophagous *Diptera* do not persist in the stomach long. 42.1% of the saprophagous group were *Diptera*, 49.7% *Lumbricidae* (as has been mentioned before, this value is in fact higher) and 8% representatives of other groups. The necrophagous group, the least numerous, consisted of *Diptera* – 93.7%, and *Coleoptera* – 6.2%. The above indicates that the percentages of the particular biological groups vary. Phytophagous species, the most abundant group in nature, constitutes the largest percentage in the food of the starling. This may, however, be due to some food preference of the starling. If so, then what is the mechanism of this process?

### 3.2.3. Food preference

Kluijver (1933) maintains that in the starling food preference does not exist, and this bird usually catches all the food that can easily be obtained in the usual way, that is to say it finds its food on the surface of immediately beneath it. It feeds in trees and in the air only when the species it preys on are available there in large numbers.

Percentage of different biological groups in the food of adult birds  
and nestlings of I and II broods

Tab. VI

Groups of animals	Percentage of the total number of specimens in different months										Total
	F	M	A	M	I brood	II brood	J	J	A	S	
<i>Polyphaga</i>	13.9	10.0	2.6	8.9	3.9	2.3	19.6	69.3	29.4	18.9	14.7
<i>Phytophaga</i>	71.3	66.9	89.1	78.2	81.2	73.8	71.2	12.4	23.6	46.5	65.7
<i>Zoophaga</i>	13.0	13.1	4.4	7.4	8.6	13.0	6.2	3.8	15.9	27.6	9.4
<i>Aphidophaga</i>		3.5	0.1		0.3	2.1	0.3	0.2	0.5	0.8	0.7
<i>Necrophaga</i>					1.1		0.3		0.1		0.4
<i>Coprophaga</i>	1.7	0.3	1.7	0.9	0.4	0.2	1.5	13.9	30.4	0.8	5.2
<i>Saprophaga</i>		5.7	1.7	4.4	3.9	8.4		0.1	0.7	5.1	3.6

In Table VII are shown percentages of various animals from different habitats and layers, in the starling food. The most abundant are the animals running or crawling over the surface, then those living beneath the earth surface (a large percentage of these are caught after their crawling to the surface, e.g., the earthworms); the animals living on plants and those in trees in particular, are the least numerous. Many of the animals that normally live on plants are caught only when they are on the ground, e.g., a Colorado beetle emerging from the earth after wintering over, or larvae of *Vanessa polychloros* L. coming down from the trees to seek suitable sites for their pupation. 93.9% of all the animals eaten come from open habitats – fields and meadows, 4.5% from wooded habitats, and 1.2% from aquatic biocenoses. It may thus be stated that the starling prefers feeding in open areas covered with a low vegetation or with no vegetation at all, and that these constitute its normal feeding niche. This niche is fairly wide, but its borderlines are not so clear-cut at those of the feeding niches of many arboreal bird species (Haftorn 1956).

Habitat niche (percentage of total number of specimens)

Tab. VII

Habitat	Edaphon	Epigeion	Epiphyton	Total
Aquatic habitats		1.2		1.2
Meadow	17.9	7.6	1.6	27.1
Meadow and field	10.6	41.8	11.9	64.3
Field		2.5		2.5
Mid-field afforestation			4.5	4.5
Total	28.5	51.9	18.0	99.6

Kluijver (1933) reports that the prey of the starling vary in body-size from 1.5 to 5 mm, while Dunnet (1955) has found that this bird does not eat animals below 1 mm in body length or above 4–5 g in body weight. The range of body size of the prey, determined in the present research, is similar to that mentioned above, and it seems that the starling equally avoids catching very large and very small animals (Tab. VIII), and that there is an optimum body size of prey for this bird species. A similar regularity has been described in the common heron (*Ardea cinerea* L.) by Owen (1955). This seemingly very simple problem is in fact much more complex. First of all, it is necessary to decide what factors determine the prey body size limits for a particular bird species. It may be presumed that the upper limit is a prey still small enough for the bird to capture it and above that range will be those animals which, because of their being too strong or having too hard a body cover, cannot be captured by the bird. As regards the starling there are essentially no insect species which it could not capture since it catches representatives of the biggest insect groups such as the cockchafers, *Melolontha melolontha*, the ground beetles or large caterpillars of *Lepidoptera*. The upper range of prey body size is thus determined by the body size of the insects occurring in the environments penetrated by the starling. The lower limit of prey body size does not seem to be determined only by the body size of the animals present there. It may be presumed that to catch animals below a certain threshold value of body size the starling spends more energy than it gains. So the lower range of prey body size would be determined by the principle of economic activity: energy gains must exceed energy losses. If so, then the smallest animals preyed upon should be those occurring in concentration. And indeed, the small forms of prey caught by the starling occur in concentrations, either in nests (ants), in dung heaps (*Aphodius* sp.) or in colonies (aphids).

A number of data indicate that the starling usually feeds upon the most abundant animal species in the niche, these animals constituting the larger part of its food. In the present research, for instance, 6 animal species constituted 76.6% of the food of the first brood nestlings, and in the food of the second brood nestlings 3 species represented 44.2%. Šlapak (1961) reports that in his investigations 4 species constituted 73.5% of the food; in Dunnet's (1955) study 81% of the food was *Tipulidae* larvae, while according to Korol'kova's (1963) report 63% of the food consisted of *Operophtera* sp. larvae. There have been many papers describing intense feeding in areas where insects occurred abundantly (Sokołowski 1949, Noll 1958, Korol'kova 1963). Starlings have also been reported (Sokołowski 1949, Wenzierl 1961, Korol'kova 1963) to feed intensely in trees, that is outside the normal feeding niche, catching the cockchafers which occur there in masses, *Lepidoptera*

Size of prey brought for the nestlings of I brood

Tab. VIII

	0-1	1-5	5-10	10-20	20-30	30-40	40-50	50-100	100-200	200-300
Dry weight in mg			43.7	15.5	7.6	1.1	10.1	6.2	6.7	3.1
Percentage of specimens	0.1	5.6	43.7	15.5	7.6	1.1	10.1	6.2	6.7	3.1

larvae and even the dragonflies (Bährmann 1953). According to Korol'kova (1963), when a forest insect species occurs in masses, it will become the main food to most of the birds present in that area, normally feeding in different vegetation layers and on different animals. Korol'kova (1963) has also found that a number of insects are not being preyed on when they occur in small numbers, but they become part of the food if they occur in masses. As has already been mentioned, the small forms caught are those occurring in colonies.

In the light of the above reasoning Kluijver's (1933) statement that the starling has no specific food preference seems right. To generalize the problem one may state that in the starling, and probably in some other polyphagous bird species as well qualitative food preference does not exist, but these birds have a quantitative food preference, expressed by their preferring to feed on forms that are actually the most abundant or occur in colonies, this being connected with the energy economy of the organism which tends to obtain the necessary amount of food at the lowest possible energy cost. Catching small prey is economical only when these occur in large numbers.

Each species has a definite feeding niche within which it feeds on that prey species whose population is at the given time the largest of all the populations present, and whose body size is suitable for the predator. If animals that can be eaten occur in masses in a different, normally not penetrated, niche then the quantitative food preference appears to be stronger than habitat preference. Consequently, many species feed together. It seems that in birds spatial stratification is associated with the existing competition for food.

As a result of its food preference the starling reduces primarily the populations of those phytophagous species which occur in the agrocenoses in large numbers and often in colonies. When these are absent, starlings feed on small polyphagous and coprophagous species which also occur in colonies. The zoophagous species, less abundant and more dispersed, are to a lesser extent fed upon.

### 3.2.4. Controlling effect on insect pests

As has been mentioned, 80% of its animal food the starling finds on the surface or immediately beneath it. 93% of all the animals eaten come from open biotopes. In agrocenoses the starling appears to be a factor controlling primarily the numbers of field and meadow insects and to a lesser extent those feeding in the trees and shrubs of the shelter belts, although its role in controlling the numbers of pests in afforested areas must not be ignored. In afforested land this bird intensely reduces the imagines of the foliage eating beetles of the family *Scarabeidae*: *Phyllopertha horticola*, *Anomala aenea* Deg. (Łącki 1960), *Amphimallon solstitialis*, and notably *Melolontha melolontha*, whose intense reduction by starlings has been reported by Šilova-Krassova (1955) and by Weinzierl (1961). Starlings appear to reduce also the numbers of the larvae, during their mass occurrence in trees, of some *Lepidoptera* families: *Notodontidae*, *Lymantridae*, *Geometridae* in forests (Kerzina 1949, Sokołowski 1949, Šlapak 1961, Korol'kova 1963), as well as in mid-field afforestations (Mel'ničenko 1949, Budničenko 1955).

Starlings also eat considerable amount of field and meadow insects, and may thus become an important controlling factor for the larvae of *Tipulidae*, *Noctuidae* (of the sub-families: *Noctuinae*, *Hadeninae*, *Zenobiinae*), for larvae and imagines of *Elateridae*, imagines of *Curculionidae* and particularly of the pests on legumes (*Sitona* sp.), larvae of *Scarabeidae*, especially of *Amphimallon solstitialis* and *Melolontha melolontha*, as reported also by Kluijver (1933), Mel'ničenko (1949), Budničenko (1955), Noll (1958), Pfabe and Szypuła-Gądor (1964) and others.

Noteworthy is the role of the starling in the control of the Colorado beetle. This insect species has long been known to be fed upon by the starling. Krasucki (1933) (after Szczepski 1957) regarded the starling to be particularly predaceous to the Colorado beetle. Lüscher (1939/1940) and Gerber (1949) thought that the Colorado beetle could be controlled successfully by the starlings. However, confirming the statement that starlings feed on the Colorado beetle some investigators (Sellke 1940, Przygoda 1952, Sokołowski 1955) are at the same time doubtful of the usefulness of starlings as a control measure against this insect pest. Recently, a considerable number of studies have been published on the starling as feeding on the Colorado beetle (Mansfeld 1954, Wuttky 1956, Theuerhauf 1957, Czarnecki and Górny 1958, Bogucki 1961, Weinzierl 1961). These findings were based mainly on the analysis of nesting material in which fragments or whole, indigested specimens of this insect species were found. During his investigation carried out at Turew Łącki (1960) found in the nesting material of 67% of nests fragments of Colorado beetle specimens; the total number of insect individuals

found in one nest came up to 70, body fragments of Colorado beetles constituting 46% of all the insect body fragments found. In spite of these findings Schick and Klinkowski in their extensive textbook on the potato plant, published in 1962, still stated that no bird species was of any practical importance in the control of Colorado beetles.

In the area here considered the Colorado beetle (only imagines) was found in the food of the starling between March and July (Tab. IV and V). Starlings pull out the imagines of this insect from beneath the thin surface layer of the soil where they hibernate, but they prey on it most intensively in the second half of May and in June when the beetles emerge from the soil and infest the sprouting potatoes. In the food of the young of the first brood Colorado beetles represent 9.4%, and of the second brood – 2.0% of the total dry mass of food. In the stomach contents of adult birds shot in June Colorado beetles constituted 15% of all prey specimens, and were the second largest group, after *Phyllopertha horticola* which was at that time the most numerous group. During the second brood Colorado beetle are among the six species that make up the greatest part of the food; this indicates that the starling does not avoid the Colorado beetles, and what is more it feeds on them equally readily as on the “native” species occurring in large numbers or even in masses. In the literature concerned papers can be found with statements that owing to the toxicity resulting from the presence of solanine, as well as due to its bad taste the Colorado beetle will never become a permanent component of the diet of insectivorous animals (Sokołowski 1955). Szczepski (1957), who tried to feed Colorado beetles to starlings in captivity, found that although the birds ate these beetles, they preferred to eat some other kind of food; before eating they tried to remove the protective secretion from the bodies of the insects by rubbing them against the ground. Birds fed Colorado beetles showed symptoms of intoxication. The symptoms were more marked in those individuals which had been starved and, which seems most interesting, their intensity varied with the individual birds. In some birds no signs of intoxication were seen during the experiments, they were therefore resistant individuals. We have thus found the path along which proceeds the adaptive selection of the starling by the Colorado beetle as its food: some individuals of a population of starlings are intolerant while others are resistant to the toxins present in the body of the Colorado beetle. Starlings eat large numbers of Colorado beetles. As a result individuals which are resistant to the Colorado beetle toxins have a better chance to survive than have those which are intolerant, and the latter are gradually eliminated from the population.

In some recent papers the severity of damage caused by the Colorado beetles in potato fields is described as being problematic and depending on the initial threshold-number of eggs per a square metre. For the Poznań province this

number has been estimated at 800 (Trojan 1968). It appears that in order to cause an effective reduction of the initial number of eggs it is necessary to place most emphasis on control measures during the hibernating period and during the spring swarming of the Colorado beetle. In view of these findings the role of the starling, which destroys the Colorado beetle in the very critical period, is very important for the controlling of this insect pest. The practical value of this controlling activity of the starling will depend exclusively on its population density in the particular area.

#### 4. CONCLUSIONS

1. The feeding niche of the starling is the open country from which 93% of its food comes. In agrocenoses, the starling reduces the numbers primarily of the field and meadow insects, though at times of strong gradations of insects in mid-field afforested areas it may become a factor reducing their populations.

2. Phytophagous and polyphagous, and in certain periods also coprophagous species, i.e., forms which are the most abundant or occur in colonies, provide most of the food of the starling, whereas the zoophagous species, being less abundant and more evenly distributed, are a less important item in the diet of this bird.

3. The starling is an important number controlling factor for the Colorado beetle; its activity leads to a reduction of the initial population size of this insect.

4. Some individuals of a starling population are intolerant and others are resistant to the toxins present in the body of the Colorado beetle. As the starlings eat large numbers of these beetles, the individuals intolerant to the toxins are gradually eliminated.

5. By feeding on plants the starling does not cause damage in agricultural regions. However, its injurious activity in cherry orchards should be prevented by frightening off the birds by means of specific sounds recorded on a magnetic tape.

6. In the starling, and probably in some other polyphagous bird species as well, no qualitative food preference can be seen; there exists, however, some quantitative food preference there, as the birds feed on prey that are abundant or occur in colonies in preference to those which are less abundant or more evenly dispersed. If the prey occur in masses outside the normal feeding niche many species will feed together, which indicates that at the time of its existence competition for food causes a spatial stratification.

7. Reproduction success depends on the amount and availability of food.

8. The practical importance of the starling for the control of crop pests depends on the size of its population. It is therefore advisable to hang nest boxes for this bird species in mid-field afforested areas.

The author wishes to express his thanks to H. Cybulska, M. Sc., for identifying the *Gastropoda*, to Docent Dr. P. Trojan for identifying the imagines of *Diptera*, to R. Hołyński, M. Sc., for the identification of most of the imagines of *Coleoptera* and to J. Karg, M. Sc., for identifying the *Hymenoptera*.

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## SKŁAD POKARMU SZPAKA (*STURNUS VULGARIS* L.) W AGROCENOZACH

### Streszczenie

Praca została oparta na materiale zebrany w latach 1965 i 1966 w okolicach Turwi w powiecie kościańskim. Na materiał składają się zawartości żołądków odstrzelonych ptaków dorosłych oraz pokarm dostarczony pisklątom przez ptaki stare. Prowadzono również obserwacje nad biologią rozrodu, liczebnością i występowaniem szpaka.

Teren badań jest obszarem typowo rolniczym. Charakteryzuje się dużą ilością zadrzewień śródpolnych występujących w postaci pasów i kęp. Kompleksy leśne są niewielkie; występują duże obszary łąk, często wilgotnych.

Materiał zbierano drogą odstrzału (ptaki dorosłe) i przewiązek szyjnych (pisklęta). Ilość zebranych żołądków, prób pokarmu i sztuk zdobyczy przedstawiają tabele I i II, a skład pokarmu ptaków dorosłych i piskląt – tabele IV i V. Występowanie pokarmu roślinnego przedstawia tabela III.

Na podstawie zebranego materiału można stwierdzić:

1. W okresie drugiego lęgu występuje wyraźne pogorszenie się warunków pokarmowych w porównaniu z pierwszym lęgiem, przejawiające się w zmniejszeniu roli dominujących grup biologicznych, zmianie sposobu odżywiania na bardziej polifagiczny, rozszerzeniu niszy żerowiskowej oraz zwiększeniu ilości egzemplarzy przy jednoczesnym zmniejszeniu ogólnego ciężaru przynieszonej zdobyczy. Wskazuje to na wzrost kosztów energetycznych wychowu jednego pisklęcia podczas drugiego lęgu. Ilość i dostępność pokarmu jest więc czynnikiem warunkującym powodzenie rozrodu, a co za tym idzie i stopień rozrodczości populacji.

2. O udziale w pokarmie ptaków dorosłych tych form zdobyczy, które występują jednakowo licznie przez cały rok, a w żołądkach źle się zachowują, należy wnioskować na podstawie ich udziału w pokarmie młodych. Dotyczy to przede wszystkim dżdżownic, których udział w pokarmie ptaków dorosłych należy przyjąć za 10–15%.

3. Szpak zjada pięć rodzajów pokarmu roślinnego. W okręgach czysto rolniczych ten rodzaj działalności nie przynosi szkód.

4. Z pokarmu zwierzęcego najliczniej zjadane są fitofagi i polifagi; w pewnych okresach także i koprofagi, a więc przede wszystkim formy o największej liczebności lub formy występujące skupiskowo. Mniej licznie występujące i bardziej równomiernie rozproszone zoofagi stanowią mniejszość pokarmu.

5. U szpaka, a prawdopodobnie i u innych polifagicznych gatunków ptaków, nie istnieje jakościowa, specyficzna w stosunku do jakiegoś gatunku zdobyczy wybiórczość pokarmowa, istnieje natomiast wybiórczość ilościowa, polegająca na preferowaniu form najliczniejszych i występujących skupiskowo. W przypadku masowego wystąpienia zdobyczy poza obrębem normalnej niszy żerowiskowej wiele gatunków żeruje wspólnie, co

świadczy o wywoływaniu stratyfikacji przestrzennej przez aktualnie działającą konkurencję o pokarm.

6. 80% zdobyczy szpaka należy do form przebywających na lub tuż pod powierzchnią ziemi, a 93% form pochodzi z biotopów otwartych. W agrocenozach szpak redukuje więc przede wszystkim owady polne i łąkowe, chociaż w przypadku silnych gradacji owadów w zadrzewieniach śródpolnych może być czynnikiem redukującym ich liczebność.

7. Szpak konsumuje znaczne ilości stonki ziemniaczanej, która w okresie pierwszego lęgu, a także w pokarmie ptaków dorosłych w czerwcu, należy do dominantów pokarmowych. Zjadane są tylko imagines stonki, łowione w okresie wiosennej rójki. Znaczenie szpaka, jako reducenta stonki, jest więc bardzo istotne, gdyż działalność jego prowadzi do zmniejszenia wyjściowej liczebności populacji.

8. Praktyczne znaczenie szpaka dla ochrony upraw polnych zależy od liczebności jego populacji. Dlatego wskazane jest rozwieszanie w zadrzewieniach śródpolnych skrzynek lęgowych dla tego gatunku.

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