

Zbigniew BOCHEŃSKI jun.

**The food of suburban Tawny Owls on the background of birds
and mammals occurring in the hunting territory**

[with Plates II—III and 5 text-figs.]

**Skład pokarmu puszczyka w terenie podmiejskim w porównaniu ze składem gatunkowym ptaków i ssaków
występujących na jego żerowisku**

Abstract. Tawny Owl pellets from the suburbs of Kraków have been analysed and the results have been compared with the relative abundance of small mammals and birds in the hunting territory. Seasonal variations in the diet are also discussed. It appeared that birds were of greater nutritional importance than mammals in that habitat. It is the most abundant species of birds and small mammals that were most frequently hunted by the owls.

CONTENTS

I. Introduction	149
II. Materials and methods	150
III. Results	153
IV. Discussion	163
References	168
Streszczenie	170

I. INTRODUCTION

There are many papers on the Tawny Owl's diet but only a few of them discuss seasonal and yearly differences in its food. The most important studies were carried out in England (SOUTHERN 1954, 1970, SOUTHERN, LOWE 1982) and in Germany (WENDLAND 1972, 1980, 1981). Tawny Owl's diet depends on the habitat and the distance from big cities (SPARKS, SOPER 1972; CRAMP 1985). Seasonal and yearly variations of the diet were studied in various habitats (SOUTHERN 1954; DELMEE et al. 1979; WENDLAND 1972, 1980, 1981). Although there are some papers on the diet of the Tawny Owl nesting in big cities (HARRISON 1960; BOGUCKI 1967), it seems that the suburban habitat has not been satisfactorily investigated. Moreover, only a few papers compare

food composition with the abundance of prey species in the hunting territory. This kind of information is very interesting both from the faunistical and the paleontological points of view (PUCEK, RACZYŃSKI 1983; KOWALSKI, in press). It is believed that some of the bird fossils found in caves are of pellet origin. In this case, it is important to know the food composition, food preference of particular birds of prey and to what extent the list of preys illustrates faunal composition of the territory.

The purpose of this paper is to determine what species are being preyed upon by Tawny Owls in the suburbs of a big city (Kraków), to show the relative importance of prey species in the owls' diet and to discuss seasonal variations in the diet. Moreover, as it was mentioned above, this paper may also be helpful in paleontological studies.

Thanks are due to Dr A. NADACHOWSKI for his laborious work of identifying small mammal remains; to Dr Z. SZYNDLAR for identifying amphibians and to Dr B. W. WOŁOSZYN for identifying bats. I am also indebted to my father Prof. Z. BOCHEŃSKI, Prof. A. GÓRECKI and Dr J. WASILEWSKI who gave many helpful comments on drafts of this paper.

II. MATERIALS AND METHODS

A detailed study was carried out on the area of about 45 ha situated on St. Salwator's Hill, SW suburbs of Kraków in 1984—1986. There is a one hundred-year-old graveyard covered with old trees (maple, horse chesnut, lime, hornbeam, ash) in the middle of the area. The graveyard borders on a cultivated corn field on the one side, and on a tree-lined avenue, on the other. Houses with tree covered gardens as well as grasslands and allotments are situated in the nearest vicinity of the graveyard (ca 200 m). The nearest wood is about 1.5 km. west of the graveyard (Fig. 1, Photos. 1—4). The area is visited by numerous strollers during weekends.

Tawny Owls have been nesting in the graveyard chapel for many years. The area investigated was probably more or less of the size of their hunting territory (SOUTHERN 1970, MEBS 1971; GLUTZ, BAUER 1980) but no observations were made to estimate the accurate borders of the hunting ground. It is believed (SOUTHERN 1954, 1970; MEBS 1971) that Tawny Owls usually hunt within their territories.

All pellets were collected from the owls' nesting place: the garret of the chapel. The pellet station was cleared in June, 1984 for the first time: the material was so big (ca 12 kg) that a sample only (ca 15% of the total weight) was used for further analysis. It had certainly been accumulated there for several dozens of years. On April 6th, 1985 the pellet station was cleared again. During 1985/1986 pellets were collected 5 times in subsequent seasons (17.05.85; 5.06.85; 19.10.85; 11.01.86 and 6.03.86). The floor of the garret was always covered with paper to separate the new pellets from eventual old ones. All

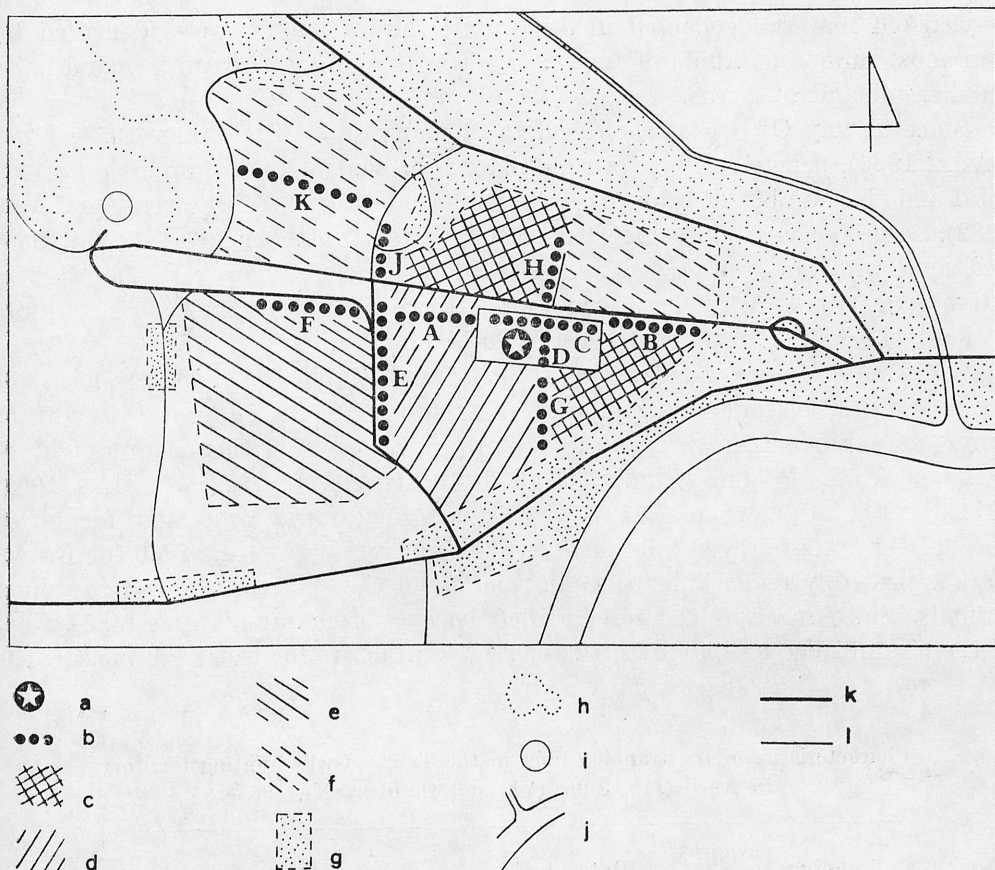


Fig. 1. Distribution of the main kinds of habitats in the vicinity of the Tawny Owls' nest from which pellet material was collected and the distribution of trapping lines. a — Tawny Owls' nest, b — trapping lines marked A—K, c — orchards, d — corn field, e — allotments (trees, vegetables, flowers), f — grassland, g — houses surrounded by trees and gardens, h — woods, i — Kościuszko Mound, j — rivers, k — main roads, l — side roads

pellets from June 1984 and April 1985 were already broken down. Whole pellets collected during 1985/86 were soaked in water and dissected. Only vertebrate remains were selected for further analysis. Invertebrates were also present in the material but they could accumulate there while pellets were lying in the garret.

Small mammals were identified by their skulls and mandibles, both having been counted and the highest figure taken. Birds from April 1985 and 1985/1986 were identified by the cranium (including rostrum), mandibula, humerus, radius, ulna, carpometacarpus, scapula, coracoideum, femur, tibiotarsus and tarsometatarsus. All kinds of bones were counted and the highest figure taken. The minimum number of individuals (MNI) was calculated for each whole pellet separately because according to RACZYŃSKI and RUPRECHT (1974) the counting error is smaller then. Due to the great abundance of the more than twenty

ty-year-old material collected in June 1984, bird remains were identified by four most numerous kinds of bones: cranium (including rostrum), mandibula, quadratum and humerus.

Since Tawny Owls cast their pellets at many sites (SOUTHERN 1954; KULCZYCKI 1964), pellets collected at one place represent a small proportion of the total and the number of prey taken is much underestimated (SOUTHERN, LOWE 1982). Some bones are also digested (RACZYŃSKI, RUPRECHT 1974; LOWE 1980) and some preys decapitated (HARRISON 1960). It seems, however, that the relative proportions of species taken by the owls and cast at that place more or less reflect the proportions of the total diet.

Conversion factors were applied to all results (Table II: „W”), taking a 20-gramme small mammal as standard (SOUTHERN 1954). The total weight of prey was expressed in „prey units” taking into accounts the mean weight of each species in Poland (PUCEK et al. 1984; JUSZCZYK 1974; FERENS 1967, 1971; HUDEC, ČERNÝ et al. 1977). This was necessary, especially for birds, because they were preyed upon heavily. The conversion factor of 5.0 for Brown Rats is probably realistic because all remains of the species belonged to young animals. Since most of the unidentified species of mammals and birds were of the size of mice or sparrows, the conversion factors for these groups are 1.0

Table I

Characteristics of the trapping lines in the Tawny Owl's hunting territory in April (IV), June (VI) and October (X), 1985

Trapping line	Approx. length (m)	Date of trappings	Characteristics of the area
A	90	IV, VI, X	Corn field adjoining the graveyard
B	160	IV, VI, X	IV — no plant cover, VI — corn field X — stubble, heaps of straw
C	250	IV, VI, X	High shrubs along Waszyngton Str.
D	90	IV	St. Salwator's Graveyard. Old trees, tombs and graves
E	190	VI, X	As above
F	170	IV	High shrubs at the edge of a corn field along Malczewski Str.
G	170	IV	Small dense shrubs and grass from the previous year near allotments
H	120	IV	Grass at the edge of a corn field
J	70	VI, X	Grass along a much-frequented dirt road
K	270	VI, X	High grass along a much-frequented dirt road
			Meadow covered with high grass

and 1.5 respectively. One must take into consideration that the conversion factors express the relative importance of prey species in the owls' diet but not their exact nutritional importance. This was already mentioned by GLUE (1967). All results were also described as proportions of total number of individuals taken by the owls. This way of presentation is somewhat traditional but it seems to be useful for some purposes too.

Birds occurring in the hunting territory were observed through the year 1985/1986. Due to different arrival and departure dates of the migratory species (SZCZEPSKI, KOZŁOWSKI 1953), the observations were then divided into two categories: summer and winter. Although no counts of birds were made, it was observed that the House Sparrow *Passer domesticus* was the predominant species.

The composition of small mammal fauna and its relative abundance was estimated by means of snap traps arranged in trapping lines which operated in all kinds of habitats in the territory (Fig. 1, Table I). The traps in one line were spaced every 14 m. Such distance is often used in small mammal trappings (SMITH et al. 1975). Trappings were carried out in April, June and October, 1985. Some of the April trapping lines had to be moved to different places in June and October because of strollers' and their dogs' penetration. All traps were inspected once a day. The killed animals supplied the skeleton collection of the Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences in Kraków.

III. RESULTS

1. Tawny Owls' diet in subsequent years

55 vertebrate species including 4 species of amphibians, 17 mammals and 34 birds were found in the material investigated (Table II). The highest number of species was found in the material which had been accumulating for more than 20 years and was collected in June 1984. At least 52 vertebrate species (4 amphibians, 15 mammals and 33 birds) were found in that material. Smaller numbers of species were found in food remains in 1984/1985 and 1985/1986 (19 and 24 species accordingly). The two years differ from each other in number of bird species only. In 1984/1985 only 9 species of birds were found while in 1985/1986 — 14.

The proportions of numbers of amphibians, mammals and birds in Tawny Owls' diet were very similar in subsequent years (Table II, Fig. 2). Birds formed more than 52% in all periods and the proportion of mammals was about 40% with slight fluctuations in subsequent years. The proportion of amphibians was small: 2.75—5.15% depending on the year.

The general proportions of amphibians, mammals and birds expressed in % of prey units were very similar to the proportions expressed in % of prey

Table II

Preys of the Tawny Owl identified in pellet materials collected at the breeding place of the owl (Kraków, St. Salvator Graveyard) in particular years: W — conversion factors for calculation of "prey units" according to the formula given by SOUTHERN (1954), MNI — minimum number of individuals, their percentages and percentages of "prey units"

Species of prey	W	Old material collected in June 1984		Material collected on 6 April 1985		Material collected 5 times till 6 March 1986		Total					
		MIN	% % of prey units	MIN	% % of prey units	MNI	% % of prey units	MNI	% % of prey units				
1	2	3		4		5		6					
<i>Talpa europaea</i> LINNAEUS, 1758	5.0	10	0.94	2.30	1	1.69	4.40	2	0.92	2.62	13	0.97	3.00
<i>Sorex araneus</i> LINNAEUS, 1758	0.5	30	2.81	0.90	—	—	—	—	—	—	30	2.23	0.70
<i>Neomys fodiens</i> (PENNANT, 1771)	1.0	2	0.19	0.12	—	—	—	—	—	—	2	0.15	0.09
<i>Crocidura suaveolens</i> (PALLAS, 1811)	0.3	20	1.87	0.36	2	3.38	0.53	—	—	—	22	1.64	0.31
<i>Myotis nattereri</i> (KUHL, 1818)	0.4	1	0.09	0.02	—	—	—	—	—	—	1	0.07	0.02
<i>Nyctalus noctula</i> (SCHREIBER, 1774)	1.5	1	0.09	0.09	—	—	—	—	—	—	1	0.07	0.07
<i>Plecotus auritus</i> (LINNAEUS, 1758)	0.4	1	0.09	0.02	—	—	—	—	—	—	1	0.07	0.02
<i>Muscardinus avellamaris</i> (LINNAEUS, 1758)	0.8	1	0.09	0.05	—	—	—	—	—	—	1	0.07	0.04
<i>Mus musculus</i> LINNAEUS, 1758	0.8	100	9.37	4.8	1	1.69	0.70	6	2.75	1.26	107	7.96	3.96
<i>Rattus norvegicus</i> (BERKENHOUT, 1769)	5.0	7	0.66	2.1	—	—	—	3	1.38	3.92	10	0.74	2.31
<i>Micromys minutus</i> (PALLAS, 1771)	0.4	1	0.09	0.02	1	1.69	0.35	2	0.92	0.21	4	0.30	0.07
<i>Apodemus agrarius</i> (PALLAS, 1771)	1.2	17	1.59	1.22	2	3.39	2.11	8	3.67	2.51	27	2.01	1.50

<i>Apodemus ex gr. sylvaticus/</i> <i>flavicollis</i>	1.2	—	—	—	3	5.08	3.17	—	—	3	0.22	0.17
<i>Apodemus</i> sp.	1.2	52	4.87	3.74	4	6.78	4.23	11	5.05	67	4.99	3.72
<i>Clethrionomys glareolus</i> (SCHREIBER, 1780)	1.2	—	—	—	—	—	—	1	0.46	1	0.07	0.06
<i>Arvicola terrestris</i> (LINNAEUS, 1758)	4.5	38	3.56	10.25	6	10.17	23.79	16	7.34	60	4.46	12.48
<i>Pitymys subterraneus</i> (DE SÉLYS-LONGCHAMPS, 1836)	1.0	35	3.28	2.10	3	5.08	2.64	6	2.75	44	3.27	2.03
<i>Microtus arvalis</i> (PALLAS, 1779)	1.4	132	12.37	11.08	1	1.69	1.23	9	4.13	142	10.57	9.19
<i>Mammalia</i> indet.	1.0	—	—	—	—	—	—	11	5.05	11	0.82	0.51
<i>Mammalia</i> total	—	448	41.99	39.90	24	40.68	43.17	75	34.40	547	40.70	40.22
<i>Columba livia (domestica)</i> GME- LIN, 1789	18.0	1	0.09	1.08	—	—	—	—	—	1	0.07	0.83
<i>Streptopelia decaocto</i> (FRIVALD- SKY, 1838)	10.0	4	0.37	2.40	—	—	—	—	—	4	0.30	1.85
<i>Streptopelia turtur</i> (LINNAEUS, 1758)	7.7	2	0.19	0.90	1	1.89	6.78	—	—	3	0.22	1.07
<i>Streptopelia turtur /decaocto</i>	8.8	—	—	—	—	—	—	1	0.46	1	0.07	0.41
<i>Apus apus</i> (LINNAEUS, 1758)	2.0	1	0.09	0.12	—	—	—	1	0.46	2	0.15	0.18
<i>Picus viridis</i> LINNAEUS, 1758	11.0	1	0.09	0.66	—	—	—	—	—	1	0.07	0.51
<i>Dendrocopos minor</i> (LINNAEUS, 1758)	1.0	1	0.09	0.06	—	—	—	—	—	1	0.07	0.05
<i>Hirundo rustica</i> LINNAEUS, 1758	1.0	5	0.47	0.30	—	—	—	1	0.46	6	0.45	0.28
<i>Delichon urbica</i> (LINNAEUS, 1758)	0.8	3	0.28	0.14	—	—	—	—	—	3	0.22	0.11
<i>Sturnus vulgaris</i> LINNAEUS, 1758	4.0	11	1.03	0.24	—	—	—	1	0.46	12	0.89	2.22
<i>Corvus monedula</i> LINNAEUS, 1758	11.2	1	0.09	0.67	—	—	—	—	—	1	0.07	0.52
<i>Sylvia nisoria</i> (BECHSTEIN, 1795)	1.2	1	0.09	0.07	—	—	—	—	—	1	0.07	0.06
<i>Sylvia borin/atricapilla</i>	1.0	3	0.28	0.18	—	—	—	2	0.92	5	0.37	0.23
<i>Sylvia communis</i> LATHAM, 1787	0.8	2	0.19	0.10	—	—	—	—	—	2	0.15	0.07

Table II cont.

1	2	3	4	5	6
<i>Sylvia curruca</i> (LINNAEUS, 1758)	0.6	—	1 1.69 0.53	1 0.46 0.16	2 0.15 0.06
<i>Sylvia communis/curruca</i>	0.7	1 0.09 0.04	—	1 0.46 0.18	2 0.15 0.06
<i>Phylloscopus</i> sp.	0.5	3 0.28 0.09	—	—	3 0.22 0.07
<i>Regulus</i> sp.	0.4	4 0.37 0.10	—	—	4 0.30 0.07
<i>Muscicapa striata</i> (PALLAS, 1764)	0.8	2 0.19 0.10	—	—	2 0.15 0.07
<i>Phoenicurus ochruros</i> (GMELIN, 1774)	0.8	2 0.19 0.10	—	2 1.38 0.63	5 0.37 0.18
<i>Erithacus rubecula</i> (LINNAEUS, 1758)	0.8	1 0.09 0.05	—	—	1 0.07 0.04
<i>Turdus pilaris</i> LINNAEUS, 1758	5.5	2 0.19 0.66	1 1.69 4.85	—	3 0.22 0.76
<i>Turdus merula</i> LINNAEUS, 1758	4.0	3 0.28 0.72	2 3.39 7.05	1 0.46 1.05	6 0.45 1.11
<i>Turdus pilaris/merula</i>	4.8	2 0.19 0.58	—	5 2.29 6.28	7 0.52 1.55
<i>Turdus philomelos</i>	3.2	1 0.09 0.19	—	—	1 0.07 0.15
C. L. BREHM, 1831	4.3	5 0.47 1.29	—	—	5 0.37 1.00
<i>Turdus</i> sp.	0.5	8 0.75 0.24	—	1 0.46 0.13	9 0.67 0.21
<i>Parus caeruleus</i> LINNAEUS, 1758	0.5	—	1 1.69 0.44	2 0.92 0.26	3 0.22 0.07
<i>Parus caeruleus/palustris</i>	1.0	11 1.03 0.66	2 3.39 1.76	11 5.05 2.88	24 1.79 1.11
<i>Parus major</i> LINNAEUS, 1758	1.0	1 0.09 0.06	—	—	1 0.07 0.05
<i>Sitta europaea</i> LINNAEUS, 1758	1.5	376 35.24 33.81	17 28.81 22.47	94 43.12 36.87	487 36.24 33.76
<i>Passer domesticus</i> (LINNAEUS, 1758)	1.0	23 2.16 1.38	1 1.69 0.88	4 1.83 1.05	28 2.08 1.29
<i>Passer montanus</i> (LINNAEUS, 1758)	1.0	2 0.19 0.12	—	—	2 0.15 0.09
<i>Fringilla coelebs</i> LINNAEUS, 1758	0.5	6 0.56 0.18	—	1 0.46 0.13	7 0.52 1.16
<i>Serinus serinus</i> (LINNAEUS, 1766)					

<i>Carduelis chloris</i> (LINNAEUS, 1758)	1.5	3	0.28	0.27	1	1.69	1.32	—	—	4	0.30	0.28
<i>Carduelis carduelis</i> (LINNAEUS, 1758)	0.8	1	0.09	0.05	—	—	—	2	0.92	3	0.22	0.11
<i>Loxia curvirostra</i> LINNAEUS, 1758	1.8	1	0.09	0.11	—	—	—	—	—	1	0.07	0.08
<i>Pyrrhula pyrrhula</i> (LINNAEUS, 1758)	1.5	1	0.09	0.09	—	—	—	—	—	1	0.07	0.07
<i>Coccothraustes coccothraustes</i> (LINNAEUS, 1758)	2.7	1	0.09	0.16	—	—	—	—	—	1	0.07	0.12
<i>Aves</i> indet.	1.5	68	6.37	6.12	6	10.17	7.93	5	2.29	79	5.88	5.48
<i>Aves</i> — total		564	52.86	56.49	33	55.93	54.01	137	62.84	734	54.61	56.39
<i>Pelobates fuscus</i> (LAURENTI, 1768)	0.9	22	2.06	1.19	—	—	—	—	—	22	1.64	0.92
<i>Bufo</i> sp. (juv.)	2.0	5	0.47	0.60	—	—	—	—	—	5	0.37	0.46
<i>Rana temporaria</i> LINNAEUS, 1758	2.3	4	0.37	0.55	—	—	—	—	—	4	0.30	0.43
<i>Rana arvalis</i> NILSSON, 1842	0.9	24	2.25	1.30	—	—	—	—	—	24	1.79	1.00
<i>Rana</i> sp.	1.6	—	—	—	2	3.39	2.82	6	2.75	8	0.60	0.60
<i>Amphibia</i> — total		55	5.15	3.63	2	3.39	2.82	6	2.75	63	4.69	3.39
Total		1067	100.00	100.00	59	100.00	100.00	218	100.00	1344	100.00	100.00

items in subsequent years (Table II, Fig. 3). Also in that case, the proportion of birds was higher than those of mammals and was estimated at 54.01—56.64% of prey units. The proportion of mammals was about 40% of prey units while amphibians remained around 2.5—3.6% of prey units.

The House Sparrow was the predominant species both in prey items and prey units (Table II, Fig. 2 and 3). Its mean proportion reached 36.24% (33.76% of prey units) and was only slightly lower than the total proportion of mammals (Fig. 2 and 3). Among birds, apart from the House Sparrow, only the genus *Turdus* played a noticeable role during 1984/1985 and 1985/1986. It accounted for 11.9% of prey units in 1984/1985 and 7.33% of prey units in 1985/1986 in Tawny Owls' diet.

On the contrary, several predominant species of mammals were found in Tawny Owls' food. The following species predominated in food remains collected in June 1984: *Microtus arvalis*: 12.37% (11.08% of prey units), *Mus musculus*: 9.37% (4.8% of prey units), *Apodemus* spp.: 6.46% (4.96% of prey units) and *Arvicola terrestris*: 3.56% (10.25% of prey units). A high proportion of mice from the genus *Apodemus* was found in 1984/1985—15.22% (9.51% of prey units) and in 1985/1986—8.72% (5.56% of prey units). The percentage for *Arvicola terrestris* in those two years are also very high: 10.17% (23.79% of prey units) in 1984/1985 and 7.34% (18.83% of prey units) in 1985/1986 (Table II). In short, the whole material was dominated by *Microtus arvalis* (10.57%), *Mus musculus* (7.96%) and *Apodemus* spp. (7.22%), and, when converted into prey units: *Arvicola terrestris* (12.48%), *Microtus arvalis* (9.19%) and *Apodemus* spp. (5.39%).

Rana spp. and *Pelobates fuscus* predominated among amphibians (Table II).

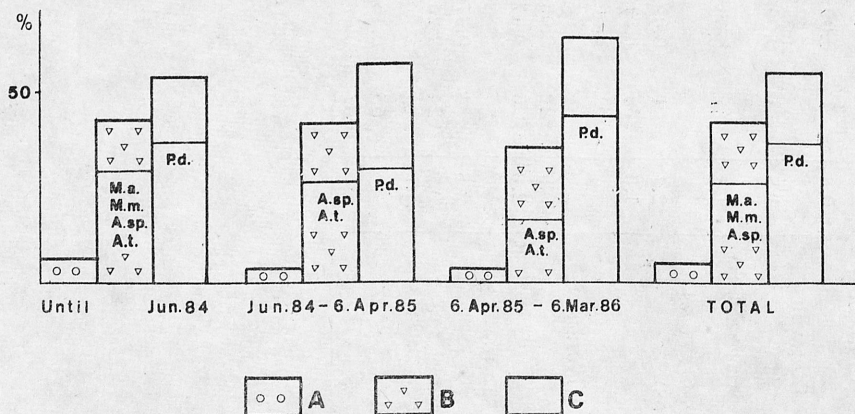


Fig. 2. Proportion of numbers of amphibians, mammals and birds in Tawny Owls' diet during the subsequent years. The percentages of dominant prey species are shown by solid lines in all histograms. Abbreviations are as follows: A — amphibians, B — mammals, C — birds, M. a. — *Microtus arvalis*, M. m. — *Mus musculus*, A. sp. — all species of the genus *Apodemus*, A. t. — *Arvicola terrestris*, P. d. — *Passer domesticus*. The species in histograms are listed in order of dominance

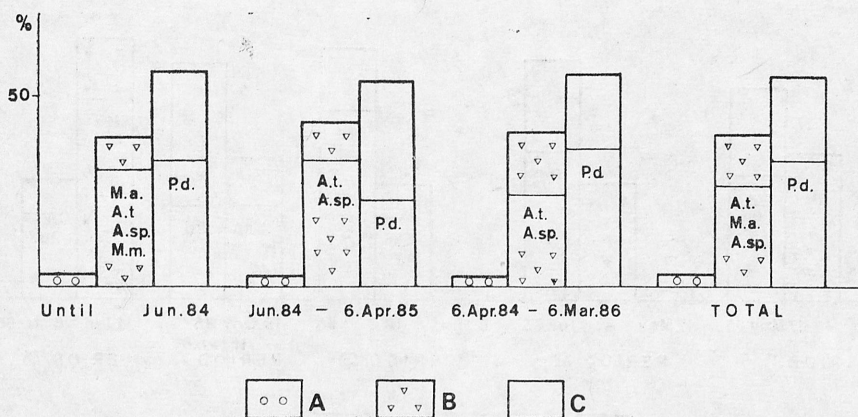


Fig. 3. Proportion of „units of prey” of amphibians, mammals and birds in Tawny Owls' diet during the subsequent years. Abbreviations as in Fig. 2

The following taxa were found in food remains each year: Mammals: *Talpa europaea*, *Mus musculus*, *Micromys minutus*, *Apodemus agrarius*, *Arvicola terrestris*, *Pitymys subterraneus* and *Microtus arvalis*. Birds: *Streptopelia* sp., *Sylvia* sp., *Turdus* sp., *Parus* sp., *Passer domesticus* and *Passer montanus*. Amphibians: *Rana* sp.

23 taxa were found only in the material collected in June 1984 and were not discovered in the next two years (Table II). 3 individuals of *Apodemus* ex gr. *sylvaticus/flavicollis* were found only in 1984/1985 and 1 specimen of *Clethrionomys glareolus* in 1985/1986 only. In all cases mentioned above, the number of individuals belonging to the species (genus) was very small.

2. Seasonal variations in the Tawny Owl's diet

Food remains were collected 5 times during 1985/1986 (Table III). The proportions of birds were higher than those of mammals in all periods except for winter (period 5) both in terms of prey items and of prey units (Fig. 4 and 5). In winter mammals became more numerous than birds. The differences between proportions of birds and mammals are smaller when they are presented in prey units (Fig. 4 and 5). There are significant differences between subsequent seasons, both in the number of species and in the number of individuals within one species. In summer and early autumn (5.06—19.10.1985), 126 individuals of vertebrate preys belonging to at least 16 species were found in food remains of the Tawny Owl (Table III). In early spring (6.04—17.05.1985), late autumn (19.10.1985—11.01.1986) and winter (11.01—6.03.1986), very few individuals were found.

Passer domesticus was the most numerous species taken by the pair of Tawny Owls through the year, what is also reflected in the percentages of prey units (Table III, Fig. 4 and 5). In summer and autumn (5.06—19.10.85) the species rose to a peak and reached 50% (41,12% of prey units) of all vertebrate preys.

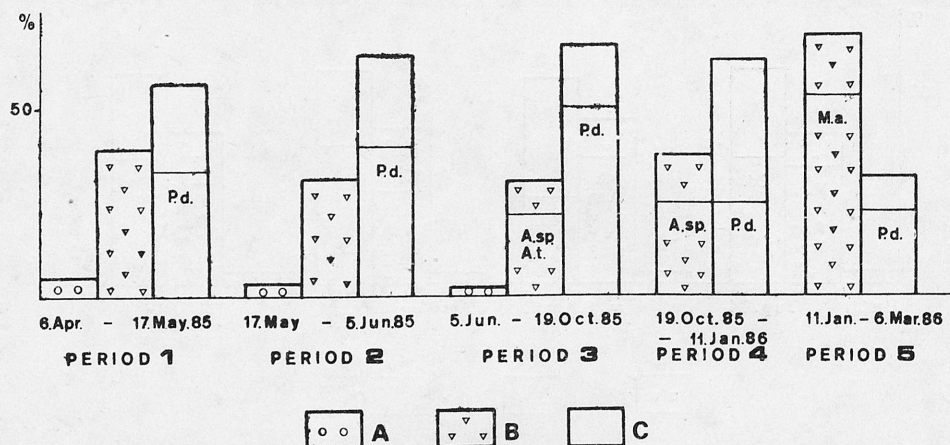


Fig. 4. Proportion of numbers of amphibians, mammals and birds in Tawny Owls' diet during the subsequent periods of the year 1985/1986. Abbreviations as in Fig. 2

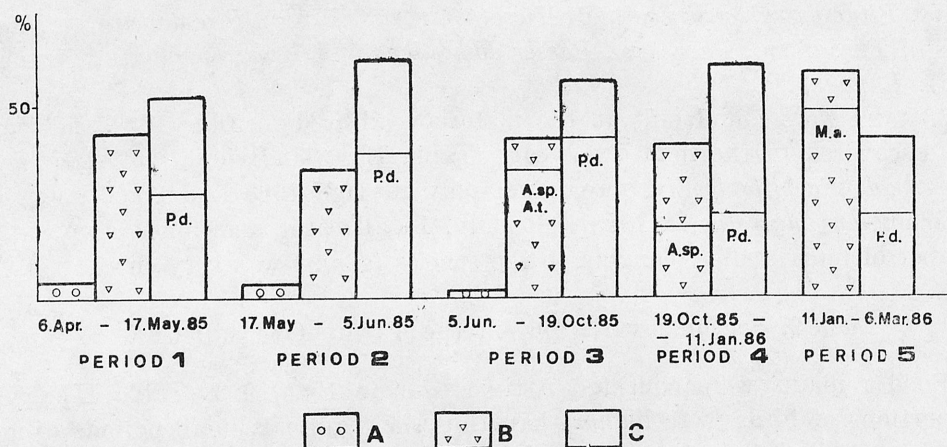


Fig. 5. Proportion of „units of prey” of amphibians, mammals and birds in Tawny Owls' diet during the subsequent periods of the year 1985/1986. Abbreviations as in Fig. 2

In the case of mammals, different species predominated in subsequent seasons. In spring (periods 1 and 2) all species of mammals were caught by the owls in similar proportions (Table III). In summer and early autumn (5.06—19.10.1985) most mammal preys consisted of mice from the genus *Apodemus* — 11.91% (7.84% of prey units) and of individuals of *Arvicola terrestris* — 10.32% (25.46% of prey units). Genus *Apodemus* also predominated in period 4 (19.10.1985—11.01.1986). In winter (11.01—6.03. 1986) nearly 54% (48.28% of prey units) of the prey eaten by Tawny Owls were individuals of *Microtus arvalis*.

Table III

Preys taken by Tawny Owls in the suburbs of Kraków during the subsequent seasons in 1985/1986. Abbreviations as in Table II

Species of prey	Period 1 6.04.85—17.05.85.			Period 2 17.05.85.—5.06.85.			Period 3 5.06.85—19.10.85.			Period 4 19.10.85—11.01.86.			Period 5 11.01.86—6.03.86.			Total 6.04.85—6.03.86.		
	MNI	%	% of prey units	MNI	%	% of prey units	MNI	%	% of prey units	MNI	%	% of prey units	MNI	%	% of prey units	MNI	%	% of prey units
<i>Talpa europaea</i>	—			2	4.44	13.91	—			—			—			2	0.92	2.62
<i>Mus musculus</i>	2	11.11	4.80	2	4.44	2.23	2	1.59	0.70	—			—			6	2.75	1.26
<i>Rattus norvegicus</i>	—			—			2	1.59	4.35	1	6.25	18.45	—			3	1.38	3.92
<i>Micromys minutus</i>	—			2	4.44	1.11	—			—			—			2	0.92	0.21
<i>Apodemus agrarius</i>	—			—			7	5.56	3.66	1	6.25	4.43	—			8	3.67	2.51
<i>Apodemus</i> sp.	—			—			8	6.35	4.18	3	18.75	13.28	—			11	5.05	3.45
<i>Clethrionomys glareolus</i>	—			—			1	0.79	0.52	—			—			1	0.46	0.31
<i>Arvicola terrestris</i>	2	11.11	27.03	1	2.22	6.26	13	10.32	25.46	—			—			16	7.34	18.83
<i>Pitymys subterraneus</i>	—			1	2.22	1.39	3	2.38	1.31	1	6.25	3.69	1	7.69	4.93	6	2.75	1.57
<i>Microtus arvalis</i>	2	11.11	8.41	—			—			—			7	53.85	48.28	9	4.13	3.29
<i>Mammalia</i> indet.	1	5.56	3.00	6	13.33	8.34	3	2.38	1.31	—			1	7.69	4.93	11	5.05	2.88
<i>Mammalia</i> — total	7	38.89	43.24	14	31.11	33.24	39	30.95	41.47	6	37.50	39.85	9	69.23	58.13	75	34.40	40.85
<i>Streptopelia turtur/decaocto</i>	—			1	2.22	12.24	—			—			—			1	0.46	2.30
<i>Apus apus</i>	—			—			1	0.79	0.87	—			—			1	0.46	0.52
<i>Hirundo rustica</i>	—			—			—			1	6.25	3.69	—			1	0.46	0.26
<i>Sturnus vulgaris</i>	—			—			1	0.79	1.74	—			—			1	0.46	1.05
<i>Sylvia borin/atricapilla</i>	—			2	4.44	2.78	—			—			—			2	0.92	0.52
<i>Sylvia curruca</i>	—			—			1	0.79	0.26	—			—			1	0.46	0.16
<i>Sylvia curruca/communis</i>	—			—			1	0.79	0.30	—			—			1	0.46	0.18
<i>Phoenicurus ochruros</i>	—			3	6.67	3.34	—			—			—			3	1.38	0.63
<i>Turdus merula</i>	—			—			—			—			1	7.69	19.70	1	0.46	1.05
<i>Turdus merula/pilaris</i>	1	5.56	14.41	—			3	2.38	6.27	1	6.25	17.71	—			5	2.29	6.28
<i>Parus caeruleus</i>	—			—			1	0.79	0.22	—			—			1	0.46	0.13
<i>Parus caeruleus/palustris</i>	—			—			1	0.79	0.22	1	6.25	1.85	—			2	0.92	0.26
<i>Parus major</i>	2	11.11	6.01	1	2.22	1.39	7	5.56	3.05	1	6.25	3.69	—			11	5.05	2.88
<i>Passer domesticus</i>	6	33.33	27.03	18	40.00	37.55	63	50.00	41.12	4	25.00	22.14	3	23.08	22.17	94	43.12	36.87
<i>Passer montanus</i>	—			2	4.44	2.78	2	1.59	0.87	—			—			4	1.83	1.05
<i>Serinus serinus</i>	—			—			1	0.79	0.22	—			—			1	0.46	0.13
<i>Carduelis carduelis</i>	—			2	4.44	2.23	—			—			—			2	0.92	0.42
<i>Aves</i> indet.	1	5.56	4.50	—			2	1.59	1.31	2	12.50	11.07	—			5	2.29	1.96
<i>Aves</i> — total	10	55.56	51.95	29	64.44	62.31	84	66.67	56.44	10	62.50	60.15	4	30.77	41.87	137	62.84	56.64
<i>Rana</i> sp.	1	5.56	4.80	2	4.44	4.45	3	2.38	2.09	—			—			6	2.75	2.51
Total	18	100.00	100.00	45	100.00	100.00	126	100.00	100.00	16	100.00	100.00	13	100.00	100.00	218	100.00	100.00

3. Occurrence of birds and mammals in the Tawny Owls' hunting area

A total of 37 species of birds were observed on the Tawny Owls' hunting territory since 6.04.1985 to 6.03.1986 (Table IV). 36 species were seen during the spring, summer and autumn of 1985 (6.04—19.10.1985) and only 13 species during the winter (11.01—6.03.1986). The House Sparrow was obviously the most abundant species on the area but no quantitative data were collected.

A total of 187 individuals belonging to 5 species of mammals were caught during the 3 subsequent trapping periods in 1985 (Table V). During the spring trapping period only 10 individuals of small mammals were captured, while 124 were trapped in October (Table V). During all trapping periods, the species *Apodemus agrarius* greatly predominated, forming 91.1—100% of the community. The remaining species were trapped sporadically.

4. Comparison of the Tawny Owls' diet and the occurrence of birds and mammals in their hunting territory

Birds

— 19 (52.8%) out of 37 species observed on the Tawny Owls' hunting territory during 1985/1986 were also found in their pellets from that time (Table III and IV). Species not taken by the owls were relatively rare and/or difficult to catch because of their size.

— All species found in food remains from 1985/1986 were also observed in the hunting territory at that time (Table III and IV).

— The House Sparrow greatly predominated both in food remains of the Tawny Owls (Fig. 4 and 5) and in their hunting territory.

— Bones of one individual of the Swallow *Hirundo rustica* were found in a pellet from period 4 (19.10.1985—11.01.1986) (Table III). This indicates that the bird occurred in the area in late October.

Mammals

— At least 9 species were found in food remains of the Tawny Owls during 1985/1986 (Table III). At that time only 5 species were captured on all trapping lines (Table V). In all periods the number of species in food remains was higher than the number of species trapped in the hunting ground.

— 2 out of 5 species captured on all trapping lines were found in pellets collected during 1985/1986 (Table III and V). The two species were: *Apodemus agrarius* and *Microtus arvalis*.

— The following 7 species found in food remains during 1985/1986 were not trapped in the hunting area at all (Table III): *Talpa europaea*, *Mus musculus*, *Rattus norvegicus*, *Micromys minutus*, *Clethrionomys glareolus*, *Arvicola terrestris* and *Pitymys subterraneus*. However, three of them: *T. europaea*, *M. musculus* and *R. norvegicus* were observed in the territory.

Table IV

Birds observed in the Tawny Owls' hunting territory during 1985/1986.
Species marked with asterisks were also found in pellets collected at that time

Species	6. 04. 1985— 19. 10. 1985	11. 01. 1986— 6. 03. 1986
<i>Falco tinnunculus</i> LINNAEUS, 1758	+	
<i>Phasianus colchicus</i> LINNAEUS, 1758	+	+
<i>Columba palumbus</i> LINNAEUS, 1758	+	
<i>Columba livia</i> (domestica) GMELIN, 1789	+	+
<i>Streptopelia decaocto</i> (FRIVALD- SKY, 1838)	+ *	+
<i>Streptopelia turtur</i> (LINNAEUS, 1758)	+ *	
<i>Apus apus</i> (LINNAEUS, 1758)	+ *	
<i>Dendrocopos major</i> (LINNAEUS, 1758)	+	+
<i>Hirundo rustica</i> LINNAEUS, 1758	+ *	
<i>Delichon urbica</i> (LINNAEUS, 1758)	+	
<i>Oriolus oriolus</i> (LINNAEUS, 1758)	+	
<i>Sturnus vulgaris</i> LINNAEUS, 1758	+ *	
<i>Pica pica</i> (LINNAEUS, 1758)	+	+
<i>Corvus frugilegus</i> LINNAEUS, 1758	+	+
<i>Corvus monedula</i> LINNAEUS, 1758	+	+
<i>Hippolais icterina</i> (VIEILLOT, 1817)	+	
<i>Sylvia borin</i> (BODDAERT, 1738)	+ *	
<i>Sylvia atricapilla</i> (LINNAEUS, 1758)	+ *	
<i>Sylvia communis</i> LATHAM, 1787	+ *	
<i>Sylvia curruca</i> (LINNAEUS, 1758)	+ *	
<i>Phylloscopus trochilus</i> (LINNAEUS, 1758)	+	
<i>Phylloscopus collybita</i> (VIEILLOT, 1817)	+	
<i>Phoenicurus ochruros</i> (GMELIN, 1774)	+ *	
<i>Phoenicurus phoenicurus</i> (LINNAEUS, 1758)	+	
<i>Luscinia megarhynchos</i> C. L. BREHM, 1831	+	
<i>Turdus pilaris</i> LINNAEUS, 1758	+ *	

Table IV cont.

<i>Turdus merula</i> LINNAEUS, 1758	+	*	+	*
<i>Parus palustris</i> LINNAEUS, 1758	+	*	+	
<i>Parus caeruleus</i> LINNAEUS, 1758	+	*	+	
<i>Parus major</i> LINNAEUS, 1758	+	*	+	
<i>Passer domesticus</i> (LINNAEUS, 1758)	+	*	+	*
<i>Passer montanus</i> (LINNAEUS, 1758)	+	*		
<i>Fringilla coelebs</i> LINNAEUS, 1758	+			
<i>Serinus serinus</i> (LINNAEUS, 1766)	+	*		
<i>Carduelis chloris</i> (LINNAEUS, 1758)	+			
<i>Carduelis carduelis</i> (LINNAEUS, 1758)	+	*		
<i>Pyrrhula pyrrhula</i> (LINNAEUS, 1758)			+	

Table V

Small mammal species trapped in the hunting territory during the three trapping periods in 1985

Species	15—18.04		25—29.06		1—11.10.		Total	
	N	%	N	%	N	%	N	%
<i>Apodemus agrarius</i>	10	100	50	94.3	113	91.1	173	92.5
<i>Apodemus sylvaticus</i>	—	—	1	1.9	1	0.8	2	1.1
<i>Apodemus</i> sp.	—	—	—	—	3	2.4	3	1.6
<i>Crocidura suaveolens</i>	—	—	—	—	3	2.4	3	1.6
<i>Microtus arvalis</i>	—	—	1	1.9	3	2.4	4	2.1
<i>Sorex araneus</i>	—	—	1	1.9	1	0.8	2	1.1
Total	10		53		124		187	

— The proportion of the genus *Apodemus* was much higher in all trapping periods than in food remains from that time (Table VI).

— All species caught on the hunting area during the three trapping periods in 1985 (Table V) were also found in food remains collected in June 1984 (Table II).

IV. DISCUSSION

1. Food composition of the Tawny Owl

All mammal and majority of bird species found in pellets were also recorded as species of prey by other authors (UTTENDÖRFER 1939; BOGUCKI 1967; CRAMP 1985). The remaining bird species which have probably been unrecor-

ded as prey species till now are represented by single individuals and, in fact, they are relatively rare (e.g. *Dendrocopos minor*, *Sylvia nisoria*). Moreover, due to the lack of comparative material many authors are able to determine only the most common bird species.

The proportion of birds in all years was higher than the proportion of mammals both by items and units of prey (Fig. 2 and 3). According to HARRISON (1960), BOGUCKI (1967) and SPARKS & SOPER (1972), birds may constitute as much as 90% of all preys of Tawny Owls in big cities. However, Tawny Owls occupying natural habitats (woodlands and other) live mainly on small mammals. In such areas, birds amount for only 1.5—8% of the owls' food (SOUTHERN 1954; DELMEE et al. 1979; KULCZYCKI 1964; SOUTHERN, LOWE 1982). A spectacular change of the Tawny Owl's diet was shown by WENDLAND (1972). Due to the habitat change the number of preyed mammals decreased and birds became the most frequently eaten preys. SPARKS and SOPER (1972) show that the relative proportions of birds and mammals in Tawny Owls' diet depend on the distance from a big city. The hunting area of the Tawny Owl investigated in this work was situated in the suburbs of Kraków and this seems to fit the rule. On the average, birds constituted 54.61% (56.39% of prey units) (Fig. 2 and 3) and mammals were the second-most important prey group — 40.70% (40.22% of prey units). Amphibians were preyed upon only sporadically, probably due to the lack of any stagnant water in the hunting territory suitable for frogs. However, according to KULCZYCKI (1964) in some areas amphibians may form the same proportion in Tawny Owls' diet as birds do (8.23%). In one case *Pelobates fuscus* formed as much as 45% of the total prey items (WENDLAND 1972) but generally amphibians are of less nutritional importance than mammals and birds (GLUTZ & BAUER 1980; CRAMP 1985).

Very few pellets were collected during the early spring, late autumn and winter 1985/1986 (Table III periods 1, 4, 5). Taking it into account it is only possible to speak roughly about the tendencies of seasonal changes in the Tawny Owl's diet. In all periods, except for winter (11.01—6.03.1986) birds were preyed upon more intensively than mammals (Fig. 4 and 5). In winter, however, the situation changed and mammals overtook birds both by items and units of prey.

2. The occurrence of birds in the hunting territory

Table IV gives the total list of birds observed in the hunting ground of the Tawny Owls. The list is certainly not complete; rare species may be missing. Also, no quantitative data were collected. It was only observed that *Passer domesticus* was the predominant species in this territory. BOCHEŃSKI and HARMATA (1962) observed at least 60 species of birds in the same area after World War II. All characteristic and predominant species observed by them were also seen during 1985/1986. Species not observed by the author of this paper

were either rare or migrant. During the winter (11.01—6.03 1986) only 13 species were seen in the area. A similar decrease in number of species was also recorded by BOCHENSKI and HARMATA (1962). According to them, the House Sparrow predominated in the territory in 1960, constituting (omitting Rooks) 11.76—26.45% of the breeding population. In winter its dominance increased to 47.6% of the wintering population.

3. The occurrence of mammals in the hunting territory

The trapping method used in this work can give only a rough idea about the occurrence and abundance of small mammals (SMITH, et al. 1975). Moreover, the October trappings were disturbed by rainfalls. It would be misleading to calculate the density of small mammals on the basis of those trappings by means of the regression method. That is why such calculations were not included in this paper. In addition, traps used in this study worked selectively and some species (e. g. *Arvicola terrestris*) could not have been caught (NADACHOWSKI, personal comment).

The Field Mouse *Apodemus agrarius* formed 92.5% out of 5 species captured in all trapping periods (Table V). Such a great predominance of the Field Mouse was already found in urban habitats such as city parks or graveyards (ANDRZEJEWSKI et al. 1978; BABIŃSKA-WERKA et al. 1979). Since the hunting territory of the Tawny Owls was situated in the suburbs of Kraków, this seems to agree with their results. However, the percentage predominance of *Apodemus agrarius* in this work is certainly overestimated because nothing is known about the abundance of the seven species hunted by the owl (Table III) and not captured during the trappings (Table V).

4. Comparison between the Tawny Owls' diet and the occurrence of birds and mammals in their hunting territory

Birds

The House Sparrow was the predominant species during all years and seasons both in the hunting territory and in the Tawny Owl's diet (Table II and III). Its diurnal activity begins about 8 minutes before sunrise and finishes after the same time after sunset (KORODI GAL 1965). Diurnal activities of many of the remaining species preyed upon by the Tawny Owls begin earlier and end later than in the case of *Passer domesticus* (KORODI GAL 1961; ASCHOFF, WEVER 1962). This leads to the conclusion that the dominance of one prey species in the hunting territory is a more important factor of Tawny Owls' diet than the rhythm of activity. In fact, the remaining bird species were both outnumbered by *Passer domesticus* in the hunting territory and preyed upon far less frequently. The conclusion is similar to the results obtained by other authors (SKURATOWICZ 1950; BOGUCKI 1967). They agree that the main diet of Tawny Owls consists

of the most numerous species. According to them *Passer domesticus* is the most important species to Tawny Owls in cities.

The reason for the absence of the Chaffinch *Fringilla coelebs* in food remains is obscure. According to BOCHEŃSKI and HARMATA (1962) the species was so common in the hunting territory in 1960 that it was included to the group of characteristic species. During 1985/1986, Chaffinches were also frequently observed. The beginning and end of diurnal activity of the species is very similar to that of *Passer domesticus*. Moreover, *Fringilla coelebs* is reported to be the predominant prey species in some areas (SOUTHERN 1954).

One individual of *Hirundo rustica* found in food remains from period 4 (19.10.1985—11.01.1986) is worth mentioning. According to BOCHEŃSKI and HARMATA (1962), the latest departure of the species in this region was on October 10th. The individual taken by the owls must have been delayed and weak.

Three species: *Sylvia nissoria*, *Coccothraustes coccothraustes* and *Loxia curvirostra* were eaten by the owls (Table II) but not observed in the hunting territory at all. However, *C. coccothraustes* nests in a nearby wood and *S. nissoria* was once seen in that wood too (BOCHEŃSKI, HARMATA 1962). The Crossbill was probably taken during migration.

Species observed by BOCHEŃSKI and HARMATA (1962) and not found in pellets collected in June 1984 were either rare or under/over the size for the owls to seize.

Mammals

A great majority of the mammal species which were preyed upon (Table II) usually inhabit open areas, parklands or gardens (PUCEK et al. 1984). Forest species are represented only by a few individuals belonging to the species *Apodemus* ex gr. *silvaticus/flavicollis*, *Muscardinus avellanarius* and *Clethrionomys glareolus*. As the nearest wood is about 1.5 kilometres from the nest, it is clear that Tawny Owls must have hunted chiefly in the nearest vicinity of their nest. It confirms the results obtained by SOUTHERN (1954, 1970) and GLUTZ & BAUER (1980).

It is interesting that, in 1984/1985 and 1985/1986, only two taxa were most frequently eaten by the owls (*Apodemus* spp. and *Arvicola terrestris*). On the contrary, four taxa predominated in food remains collected in 1984 (*Microtus arvalis*, *Mus musculus*, *Apodemus* spp. and *Arvicola terrestris*). It should be remembered, however, that the remains accumulated for many years. On the other hand, all of these species are often eaten by Tawny Owls inhabiting similar habitats (KULCZYCKI 1964; BOGUCKI 1967; SKURATOWICZ 1950; PUCEK et al. 1984). The proportions of *Microtus arvalis* in the materials of 1984/1985 and 1985/1986 were much lower than in the material collected in June 1984, either because of the year-to-year variations in its abundance or due to habitat changes. In the course of years the habitat has changed: trees and shrubs have covered some parts of the hunting territory and this must have influenced the composition of small mammal fauna.

A few relatively rare species (e.g. bats) were found in pellets collected in June 1984 and were not reported from later material (Table II). Some unidentified individuals of bats were observed by the author in the last years but their number has recently been very scarce.

The Field Mouse was not only the most numerous species in the area but also the most-frequently captured species by Tawny Owls (Table VI). No accurate comparison can be made because traps are somewhat selective themselves and also the owls spent some of their time catching animals away from the trapping area. However, this was the main area hunted over, so the results

Table VI

Comparison between the proportion of the genus *Apodemus* in mammal preys in Tawny Owls' diet in 1985/1986 and the proportion of the genus in trapping results from that time

	% of individuals in pellets					Total
	6.04— 17.05.85	17.05.— 5.06.85	5.06.— 19.10.85	19.10.85— 11.01.86	11.01.— 6.03.86.	
<i>Apodemus</i>	—	—	38.5	66.7	—	25.3
Other mammal species	100	100	61.5	33.3	100	74.7

	% of trapped individuals			
	IV	VI	X	Total
<i>Apodemus</i>	100	96.2	94.3	95.2
Other mammal species	—	3.8	5.7	4.8

can be used as an indicator of prey available and taken. Noticeable in all trapping periods is the great predominance of the genus *Apodemus* (on the average 95.2% of the total number of small mammals trapped). Field Mice were also the most numerous species taken by the owls during summer, autumn and the first part of winter (Table III periods 3, 4). Their proportion, however, was much lower (38.5 — during period 3 and 66.7% of the total number of small mammals taken during period 4). Similar results have been obtained by GLUE (1967) and SOUTHERN and LOWE (1982). Probably due to local seasonal migration, no Field Mice were found in food remains during the remaining periods.

Microtus arvalis was taken by the owls during early spring and winter only (periods 1, 5); being, in the later period, the predominant species. Since no trapping was carried out in winter, it is difficult to evaluate the relative abundance of the species at that time. It seems, however, that the owls may have

found *Microtus arvalis* easier to catch than other species during early spring and especially winter.

Due to trap selectivity no individuals of *Arvicola terrestris* were trapped but since the species was preyed upon heavily (Table II and III), it certainly occurred in the hunting territory. According to CAIS (1974), the species is always taken by the owls in fairly big proportions in the area of its distribution.

Summarizing, it seems to be clear that the Tawny Owl mainly feeds on the most abundant species (birds and mammals) but the proportions of prey species do not reflect their relative abundance in nature. Species less frequently occurring in the hunting territory are of less nutritional importance. This confirms the theory to the effect that when the preys are very small in relation to their predators, food selection of the predators depends on the density of preys available (GOSZCZYŃSKI 1974). These results may be, to some extent, helpful in reconstructions of fossil bird and mammal communities.

Institute of Systematics
and Evolution of Animals
Polish Academy of Sciences
Sławkowska 17
31-016 Kraków, Poland

REFERENCES

- ANDRZEJEWSKI R., BABIŃSKA-WERKA J., GLIWICZ J., GOSZCZYŃSKI J., 1978. Synurbanization processes in population of *Apodemus agrarius*. I. Characteristic of populations in an urbanization gradient. Acta theriol., Białowieża, **23** (20): 341—358.
- ASCHOFF J., WEVER R., 1962. Begin und Ende der taglichen Aktivität freilebender Vögel. J. Ornith., Berlin, **103**: 2—27.
- BABIŃSKA-WERKA J., GLIWICZ J., GOSZCZYŃSKI J. 1979. Synurbanization processes in a population of *Apodemus agrarius*. II. Habitats of the striped field mouse in town. Acta theriol., Białowieża, **24** (30): 405—415.
- BOCHEŃSKI Z., HARMATA W. 1962. Ptaki południowego krańca Jury Krakowsko-Wieluńskiej. Acta zool. cracov., Kraków, **8**: 483—574.
- BOGUCKI Z., 1967. O pokarmie puszczyka (*Strix aluco* L.) gnieźdzącego się w śródmieściu Poznania. Przegl. zool., Wrocław, **11**: 71—74.
- CAIS L., 1974. Badania nad morfologią i rozmieszczeniem geograficznym karczownika *Arvicola terrestris* L. 1758 w Polsce. Pr. Kom. Biol., **37**, Warszawa—Poznań.
- CRAMP S. (ed.), 1985. Handbook of the birds of Europe, the Middle East and North Africa: the Birds of the Western Palearctic. IV. Terns to Woodpeckers. Oxford, New York. Oxford Univ. Press. 616 pp.
- DELMEE E., DACHY P., SIMON P., 1979. Etude comparative du régime alimentaire d'une population forestière de Chouettes hulottes (*Strix aluco*). Le Gerfaut, Bruxelles, **69** (1): 45—77.

- FERENS B. (ed.) 1967. Klucze do oznaczania kregowców Polski. Część IV A, PWN, Warszawa, Kraków, 414 pp.
- FERENS B. (ed.) 1971. Klucze do oznaczania kregowców Polski. Część IV B, PWN Warszawa, Kraków, 249 pp.
- GLUE D. E. 1967. Prey taken by the Barn Owl in England and Wales. *Bird Study*, Oxford, **14** (3): 169—183.
- GLUTZ von BLOTZHEIM U., BAUER K. M. 1980. Handbuch der Vogel Mitteleuropas. Akademische Verlagsgesellschaft, Wiesbaden, 9, 1145 pp.
- GOSZCZYŃSKI J. 1974. The effect of predatory birds and mammals on populations of their prey. *Wiad. Ekol.*, **20** (3): 207—239.
- HARRISON C. J. O. 1960. The food of some urban Tawny Owls. *Bird Study*, Oxford, **7**: 236—240.
- HUDEK K., ČERNÝ W. et. al., 1977. Fauna ČSSR. Ptaci **2**. Akademia, Praha: 838—859.
- JUSZCZYK W. 1974. Płazy i gady krajowe. PWN, Warszawa, 722 pp.
- KORODI GAL J. 1961. Durata activitatii diurne la unele specii de pasari in cursul unui an. *Studii si serc. de biol. Edit. Acad. RPR*, **11** (1): 103—121.
- KORODI GAL J. 1965. Der Nahrungsverbrauch und sein Zusammenhang mit der Tagesaktivität einiger Vögel. *Zoologische Abhandlungen*, **28**: 95—102.
- KOWALSKI K. (in press). Some problems of the taphonomy of small mammals.
- KULCZYCKI A. 1964. Badania nad składem pokarmu sów z Beskidu Niskiego. *Acta zool. cracov.*, Kraków, **9**: 529—559.
- LOWE V. P. W. 1980. Variation in digestion of prey by the Tawny Owl (*Strix aluco*). *J. Zool.*, London, **192**: 283—293.
- MEBS T. 1971. Eulen und Kauze. Kosmos, Stuttgart, 134 pp.
- PUCEK Z., et. al. 1984. Klucz do oznaczania ssaków Polski. PWN, Warszawa, 384 pp.
- PUCEK Z., RACZYŃSKI J. 1983. Atlas rozmieszczenia ssaków w Polsce. PWN, Warszawa, 188 pp.
- RACZYŃSKI J., RUPRECHT A. L. 1974. The effect of digestion on the osteological composition of owl pellets. *Acta ornith.*, Warszawa, **14** (2): 25—38.
- SKURATOWICZ W. 1950. Badania nad składem pokarmu puszczyka (*Strix aluco*) w latach 1946/48. *Pr. Kom. Biol. PTPN, Poznań*, **12**: 226—236.
- SMITH M. H., et. al. 1975. Density estimations of small mammal populations. In: GOLLEY F. B., PETRUSEWICZ K., RYSZKOWSKI L. Small mammals: their productivity and population dynamics. Cambridge Univ. Press, Cambridge: 25—54.
- SOUTHERN H. N. 1954. Tawny Owls and their prey. *Ibis*, London, **96**: 384—410.
- SOUTHERN H. N. 1970. The natural control of a population of Tawny Owls (*Strix aluco*). *J. Zool.*, London, **162**: 197—285.
- SOUTHERN H. N., LOWE V. P. W. 1982. Predation by Tawny Owls (*Strix aluco*) on Bank voles (*Clethrionomys glareolus*) and Wood mice (*Apodemus sylvaticus*). *J. Zool.*, London, **198**: 83—102.
- SPARKS J., SOPER T. 1972. Owls. Their natural and unnatural history. David & Charles, Newton Abbot, 206 pp.
- SZCZEPSKI J. B., KOZŁOWSKI P. 1953. Pomocnicze tabele ornitologiczne. PWN, Warszawa, 153 pp.
- UTTENDÖRFER O. 1939. Die Ernährung der Deutschen Raubvögel und Eulen und ihre Bedeutung in der heimischen Natur. Verlag J. Neumann, Berlin, 412 pp.
- WENDLAND V., 1972. Zur Biologie des Waldkauzes (*Strix aluco*). *Die Vogelwelt*, Berlin — München, **93** (3): 81—91.
- WENDLAND V., 1980. Der Waldkauz (*Strix aluco*) im bebauten Stadtgebiet von Berlin (West). *Beitr. Vogelkd. Leipzig*, **26** (34): 157—171.
- WENDLAND V., 1981. Cyclic population changes in three mouse species in the same woodland. *Oecologia*, **48**: 7—12.

Badaniami objęto obszar przypuszczalnego żerowiska puszczyka *Strix aluco*, gnieźdzącego się na pd.-zach. przedmieściach Krakowa (fig. 1, fot. 1—4). Wypluwki zbierano z miejsca gnieźdzenia się sowy, tj. ze strychu kaplicy na Cmentarzu Salwatorskim. Przy analizowaniu wypluwek materiał podzielono na trzy części: materiał ponad 20-letni, zebrany w czerwcu 1984; materiał z roku 1984/1985 oraz 1985/1986 (tabela II). W roku 1985/1986 zbadano również zmienność sezonową pokarmu puszczyka (tabela III). Materiał przedstawiono na dwa sposoby: jako udział procentowy osobników oraz jako udział procentowy jednostek ofiar (SOUTHERN 1954).

Ogółem w badanym pokarmie puszczyka stwierdzono 55 gatunków ofiar (4 gatunki płazów, 17 ssaków i 34 ptaków) (tabela II). Największy udział w pokarmie puszczyka stanowiły ptaki: średnio w całym materiale — 54,61% (tj. 56,39% jednostek ofiar). Średni udział ssaków wynosił odpowiednio 40,70% (40,22% jednostek ofiar) a płazów 4,69% (3,39% jednostek ofiar) (tabela II, fig. 2 i 3). Wyniki te mają charakter pośredni między otrzymanymi w mieście i w środowisku naturalnym (leśnym), co potwierdza teorię o zróżnicowaniu diety w zależności od stopnia zurbanizowania żerowiska. Spośród ptaków zdecydowanie najczęściej łapanym gatunkiem był wróbel domowy, którego udział wynosił średnio 36,24% (33,76% jednostek ofiar). W przypadku ssaków w pokarmie puszczyka dominowały następujące gatunki: *Microtus arvalis*, *Mus musculus*, *Apodemus* spp. i *Arvicola terrestris*.

W ciągu wszystkich kolejnych okresów roku 1985/1986, z wyjątkiem zimy, udział ptaków w pokarmie puszczyka był większy niż udział ssaków (tabela III, fig. 4 i 5). W zimie (11.01—6.03.1986) udział ssaków był większy. Gatunkiem dominującym we wszystkich okresach był wróbel domowy, którego udział w pokarmie w lecie i wczesną jesienią osiągnął 50% (41,12% jednostek ofiar) (fig. 4 i 5). W przypadku ssaków, w lecie dominowały osobniki z gatunku *Arvicola terrestris* i rodzaju *Apodemus*, a w zimie *Microtus arvalis* (fig. 4 i 5).

W roku 1985/1986 obserwowano na badanym terenie 37 gatunków ptaków — w tym 13 gatunków w zimie (tabela IV). 19 z nich stwierdzono również w wyplawkach puszczyka. Gatunkami nie wykorzystanymi przez sowy były ptaki rzadkie lub niemożliwe do złapania ze względu na swe rozmiary. Wszystkie gatunki ptaków stwierdzone w pokarmie puszczyka obserwowano również w terenie w promieniu ok. 0,5 km od gniazda.

W roku 1985 przeprowadzono również 3 odłowy drobnych ssaków na pułapko-linie operujące w różnych środowiskach (tabela I). W ciągu wszystkich odłowów złapano 5 gatunków drobnych ssaków (tabela V), z których tylko 2 stwierdzono również w wyplawkach z tego okresu. Wszystkie gatunki były jednak obecne w wyplawkach puszczyka zebranych w czerwcu 1984. W pokarmie sowy z 1985/1986 r. stwierdzono 9 gatunków drobnych ssaków (tabela III). Rodzaj *Apodemus* stanowił średnio 95,2% wszystkich ssaków odłowionych na pułapko-linie (tabela VI), jego udział w pokarmie puszczyka w lecie i w jesieni

1985 natomiast wynosił odpowiednio 38,5% i 66,7% (tabela VI, okresy 3 i 4). Wielkości te różnią się znacznie ze względu na niedoskonałość zastosowanych metod badawczych. Można jednak stwierdzić, że gatunki dominujące liczebnie na terenie żerowiska puszczyka (wróbel domowy, rodzaj *Apodemus*) odgrywają podstawową rolę w jego odżywianiu.

Redaktor pracy: prof. dr Z. Bocheński

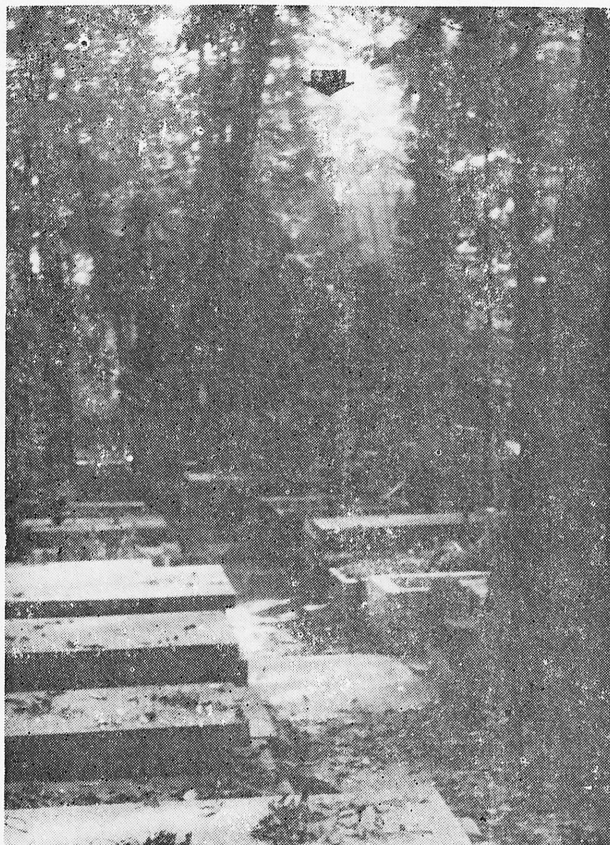
Plate II

Phot. 1. St. Salwator's Graveyard. The chapel, the nesting place of the Tawny Owls, is indicated by the arrow. The trapping lines marked C and D operated in the area

Phot. Zb. Bocheński

Phot. 2. High shrubs along Waszyngton Str. The trapping line marked B operated in the area

Phot. Zb. Bocheński



1



2

Plate III

Phot. 3. Grassland bordering a much-frequented dirt road. The trapping line marked H was situated along the road

Phot. Zb. Bocheński

Phot. 4. Grassland bordering a small wood. The meadow was crossed by the trapping line marked K

Phot. Zb. Bocheński



3



4

