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**Food of the Barn owl, *Tyto alba guttata* (C.L.BR.)
from Kujawy**

[With 1 tables and 2 text-figures]

Abstract. From the pellet material of *Tyto alba guttata* (C.L.BR.) collected in 29 localities situated in Kujawy (central Poland) in the autumn of 1964 there were bony remains of 16,944 individuals of small vertebrates, among which frogs constituted 1.9% (1 species), birds — 13.1% (19 species), small mammals — 85.0% (25 species). The method for determining the number of individuals from pellets is presented. The age structure of skulls of *Passer domesticus* (L.) in collections of pellets from places where this species was common was analysed.

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INTRODUCTION

Literature on the diet of owls occurring in Poland is fairly abundant. Most attention has been paid to the Barn owl, the diet of which has been studied in different parts of the country and in different seasons (CZARNECKI et al. 1955; CAIS 1963; KULCZYCKI 1964; RUPRECHT 1964 and 1971a; NIKODEM 1974). The diet of the Tawny owl has been the subject of the studies of SKURATOWICZ (1950), SERAFIŃSKI (1954), CAIS (1963) and KULCZYCKI (1964) while similar investigations on the food of the Long-eared owl and the Eagle

owl have been carried out by CZARNECKI (1956) and BOCHEŃSKI (1960). The diet of the Little owl has been analysed by CAIS (1963) and KULCZYCKI (1964).

The fact that the diets of owls from Wielkopolska (CZARNECKI et al. 1955; CZARNECKI 1956) and the mammalian fauna of the yewtree preserve in Wierzchnas (STRAWIŃSKI 1956) have been investigated, both in the vicinity of Kujawy, induced me to begin similar investigations there (RUPRECHT 1964, 1971a; RUPRECHT in press). Such investigations had not been done previously in this area.

The objective of this paper was: a) to analyse the diet of the Barn owl in Kujawy, b) to repeat my investigations begun earlier and now finished which dealt with the distribution of small mammals in that region.

I would like to express my gratitude to those persons who have helped me to collect the material, especially to Messrs. Stefan BUSZKO and Tadeusz BUCHALCZYK (M.Sc.) my colleagues from Mammals Research Institute at Białowieża. I am particularly grateful to my wife Joanna for her work in describing the material from Kujawy and for her technical help. I wish to thank Prof. Dr. Zdzisław PUCEK for making my studies possible. Dr. V.P.W. LOWE kindly reviewed the English text.

MATERIAL AND METHODS

The present study is an analysis of pellets of the Barn owl collected once during the autumn of 1964 from each of 29 stations situated in Kujawy. The present paper does not include other collections described earlier (RUPRECHT 1964 and 1971a) or the very small amount of material which was the basis of a faunistic description of Kujawy (RUPRECHT in press). The locations of the 29 stations of the Barn owl are presented in alphabetical order in Fig. 1. The species composition of pellet collections is presented in the same order in Table 1 and the Appendix to Table 1.

Pellets were prepared after being soaked in water and were divided into two groups: 1) complete pellets and 2) parts of pellets. Bony remains from pellets consist of skulls, mandibles, teeth (M_1 for *Microtidae*) and pelvic bones as well. Frogs were identified on the basis of morphological features of the skull and bones of the postcranial skeleton (SCHAEFER 1932). Bird skulls were identified mainly by comparisons with skull patterns of different species and craniometric methods (FICKENSTEIN 1937; RUPRECHT 1967). Skulls of the House sparrow, from collections in which it occurred frequently, were divided into three age groups on the basis of the degree of ossification by means of the NERO method (1951) — in order to establish the relationship between the age of sparrows and their capture by owls. Mice from the subgenus *Sylvaemus* were identified on the basis of teeth measurements (HAILLINGER & RUPRECHT

1967). In the case of *Soricidae*, measurements, which make it possible to identify a species from skull fragments, were used (RUPRECHT 1971b).

The number of individuals of a given species in a collection was determined on the basis of the largest number of one of the identifiable elements (the skull, right or left half of the maxilla or the mandible). This method was also applied to the summing of remains from complete or parts of pellets. In the case of mice of the genus *Apodemus* there were usually fewer number of mandibles than skulls whereas in the case of voles of the genus *Microtus* there were fewer skulls than mandibles. For damaged skulls of the genus *Apodemus* and for toothless voles (except the genera *Clethrionomys* and *Pitymys* easily differing from *Microtus*), the so-called balancing method was used. The method is based on completing the proper amount of specimens by adding to identifiable elements corresponding numbers of right or left mandibles or skulls of these rodents coming from the both groups *Apodemus* sp. and *Microtus* sp. In this way the abundance of the group of unidentified *Apodemus* sp. and *Microtus* sp. is decreased. Percentage of occurrence of species in the sample was calculated in comparison to total number of vertebrates.

The percentage of particular components of the food of owls according to the frequency of occurrence was differentiated after SKURATOWICZ (1950) into four categories: (1) basic food consisted of prey species occurring with a frequency over 20 %; (2) constant food — prey species occurring with a frequency of 5–20 %; (3) supplementary food — prey species occurring with a frequency of 1–5 % and (4) chance food — prey species occurring with a frequency below 1 %.

DESCRIPTION OF THE STUDY AREA

Kujawy constitutes the eastern part of Wielkopolsko-Kujawska Plain with Bydgoszcz on its north-western border and Gostynin on its south-eastern border (Fig. 1). Kujawy is mostly a lowland area characteristic of the Belt of Large Plains. Kujawy is situated at 100–150 m above sea level. The configuration of the area is that of a plain, diversified only by small elevations, formed as a result of glaciation, sometimes abundant in post-glacial lakes. The climate of Kujawy is that of a plain — temperate. Because of the character of soil, Kujawy is divided into: (1) white Kujawy — the northern part which is sparsely populated and where soils are not very fertile, barren and sandy as a result of the influence of glacial waters and (2) black Kujawy with fertile soils composed of marshy steppe black soil. The fertile parts, formed as a result of gradual overgrowing of lakes after the glacier receded, stretch from the river Noteć, the lakes — Mątwy and Pakość to the river Zgłowiączka. Forests — mainly pine — cover only 16 % of this area (Kujawy — a tourist guide).

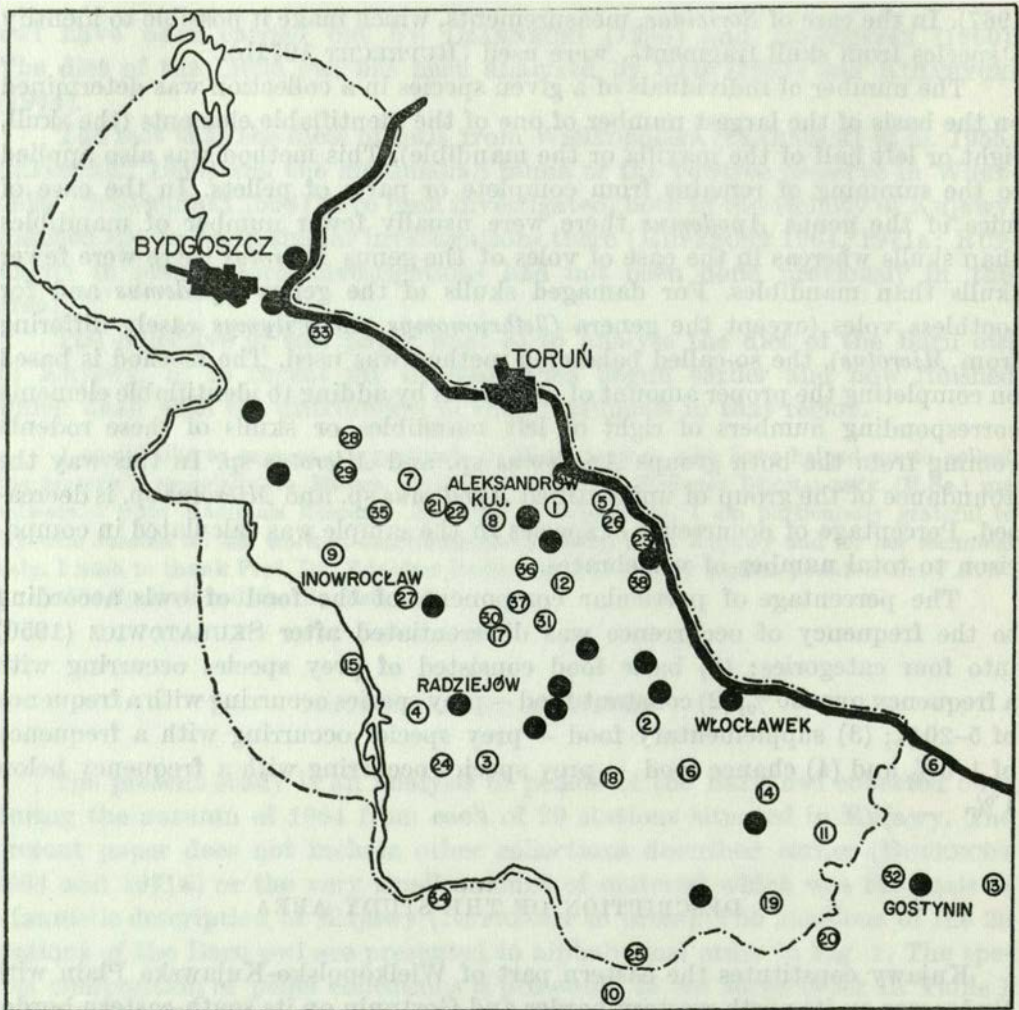


Figure 1. Distribution of known localities of the Barn owl in Kujawy. Black circles – negative result of an inspection, white ones – localities in which pellets were collected. Boundaries of the region after “Kujawy – a tourist guide, 1951”.

1 – Aleksandrów Kujawski, 2 – Brześć Kujawski, 3 – Bytoń, 4 – Chełmce, 5 – Ciechoćinek, 6 – Duninów nad Wisłą, 7 – Gniewkowo, 8 – Grabie, 9 – Inowrocław, 10 – Kłodawa, 11 – Kłotno, 12 – Koneck, 13 – Korzeń Królewski, 14 – Kowal, 15 – Kruszewica, 16 – Kruszynek, 17 – Krzywosądz, 18 – Lubraniec, 19 – Lubień Kujawski, 20 – Łanięta, 21 – Murzynko, 22 – Murzynno, 23 – Nieszawa, 24 – Piotrków Kujawski, 25 – Przedecz, 26 – Raciążek, 27 – Radojewice, 28 – Rojewice, 29 – Rojewo, 30 – Sędzin, 31 – Siniarzewo, 32 – Solec, 33 – Solec Kujawski, 34 – Sompolno, 35 – Szadłowice, 36 – Straszewo, 37 – Zakrzewo, 38 – Zbrachlin.

In Table 1 collections worked out previously (No: 5, 23 and 26) and those of a very low abundance (No: 4, 12, 13, 16, 18 and 22) have not been included.

RESULTS

Percentage of vertebrates in the diet of the Barn owl

Frogs

Frogs constituted 1.9% of the total number of vertebrates in the diet of the Barn owl in Kujawy. The dominant species was *Pelobates fuscus* LAUR. and its percentage in the food of *T. alba* varied. Usually the Common spadefoot was a supplementary element of the food (1–5%), and sometimes even a chance one (less than 1%). *P. fuscus* was a constant component of the diet of owls in Inowrocław (9.6%) and in Piotrków Kujawski (10.8%) that which indicated that it found conditions most suitable on the soils of black Kujawy (Table 1).

Birds

Birds recorded in the food of *T. alba* in Kujawy were small forms from the order of swifts and passerines (19 species) and constituted 13.1% of the total number of vertebrate animals.

Among passerine birds remains of the *Ploceidae* were most common; the most abundant was the House sparrow, partially replaced by the Tree sparrow in some localities. Most frequently the places in which pellets were collected were small towns, villages and hamlets, where house sparrows were abundant. The sociability of sparrows, their noisy behaviour were additional factors that made it easier for owls to catch them. In Kujawy the House sparrow constituted a constant component of the food of the Barn owl. Sometimes, however, it was the basic component as in the case of Kłodawa (20.7%), Zbrachlin (23.3%) and Lubień Kujawski (26.3%). Only in Radojewice, Rojewice and Rojewo was the percentage of *P. domesticus* as low as 2.8, 3.0 and 3.9%, thus forming a supplementary component (Table 1).

In four selected samples of *P. domesticus* skulls coming from stations where House sparrow occurred frequently in pellets, similar percentages of individuals with incompletely ossified skulls and skulls fully developed were observed. The percentage of intact skulls of *P. domesticus* in relation to the total abundance of the species in a given collection was also similar. The percentage of House sparrow skulls that had not been pecked to bits and those with holes (most of the damages were in the brain-pan which made it impossible to estimate the age of that part of the material) in the total collection ranged from 24–31%. The ratio of incompletely ossified skulls to those fully developed was usually constant — 1:1 in all the three collections. An exception was the collection of skulls from Kowal in which adult sparrows prevailed. Young of *P. domesticus* at the age of 123 days were caught immediately after becoming independent and later i.e. in spring, summer and autumn. These were birds from three clutches wandering in large flocks at that time. In winter, barn owls caught sparrows

at a more advanced age (124–186 days and older ones). It is worth pointing out that entirely different ratios were recorded in a sparrow skulls obtained from shooting and catches in nets; in the case of the Białowieża population the ratio of young to old birds was 2 : 1 (Fig. 2).

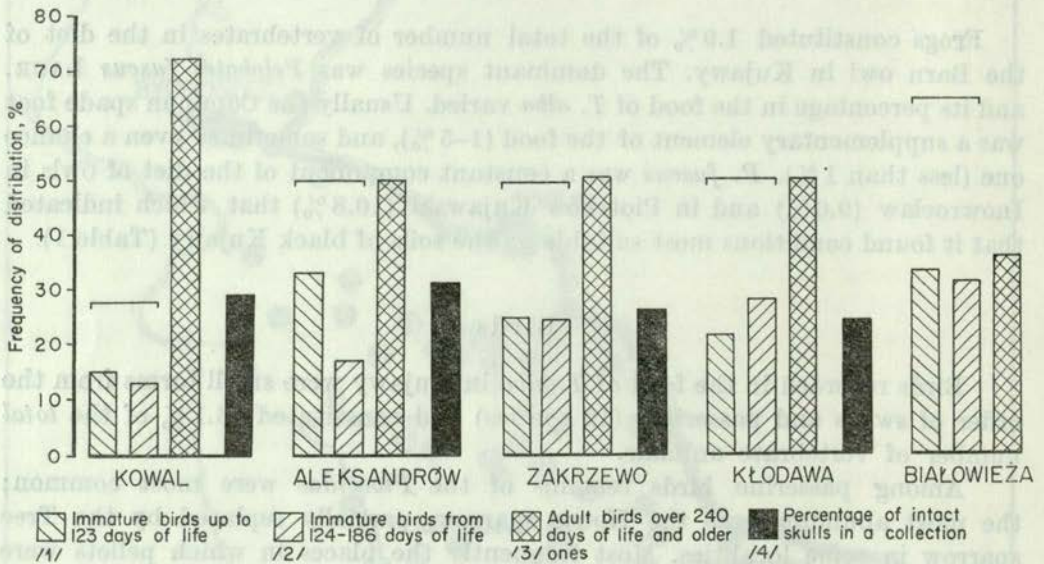


Figure 2. Age structure of intact skulls of *P. domesticus* in pellets in comparison with material obtained from catches in nets. (1) — immature birds up to 123 days of life; (2) — immature birds from 124–186 days of life; (3) — adult birds over 240 days of life and older ones; (4) — percentage of intact skulls in a collection. Age designations after NERO (1951).

It has been possible to identify the following additional species of *Passeriformes*: *Galerida cristata* (L.), *Alauda arvensis* L., *Parus maior* L., *Phoenicurus ochruros* (GM.), *Ph. phoenicurus* (L.), *Erithacus rubecula* (L.), *Acrocephalus schoenobaenus* (L.), *Sylvia atricapilla* (L.), *Prunella modularis* (L.), *Anthus pratensis* (L.), *Motacilla flava* (L.), *Sturnus vulgaris* L., *Carduelis chloris* (L.), *C. carduelis* (L.), *Emberiza calandra* L. and *E. citrinella* L. Under the conditions of Kujawy these constituted a chance component of the food of Barn owls, similar to the Swift, *Apus apus* (L.), skulls of which were found in Barn owl pellets from Inowrocław, Solec Kujawski and Kowal. Swift remains has been also recorded in *T. alba* pellets by UTTENDÖRFER (1939).

Small mammals

In respect of abundance they were the main diet of owls, constituting 85.0% of the total number of vertebrate animals found in their pellets. The total percentage of insectivorous mammals, bats and rodents were 17.1, 0.3 and 82.6% respectively. The most abundant species among *Insectivora* were

as follows: *Sorex araneus* L., among *Chiroptera*: *Eptesicus serotinus* (SCHREB.) and *Plecotus auritus* (L.), among *Rodentia*: *Mus musculus* L. and *Microtus arvalis* (PALL.) — Table 1 and Appendix to Table 1.

The percentage of insectivorous mammals in the food of Barn owls was characterized by a considerable differentiation, conditioned by local factors. Sometimes, considerable numbers of the Common shrew, *Sorex araneus* L. occurred in pellets in some places (34.8% in Sompolno, 49.5% in Rojewo), and in these localities this species was the main component of the food of the Barn owl. The former consists of wet meadows, gardens and a mixed forest; the latter of larger forest areas providing optimum conditions for shrews. The lowest percentage of the Common shrew — 1.1% — was recorded in Kłodawa which is a urban locality (Table 1). The highest percentage of the Pigmy shrew, *Sorex minutus* L. as a constant component of the food of owls was recorded in Rojewo (6.8%), Rojewice (4.5%) and Radojewice (7.9%). It is worth stressing that in pellets from these places high percentage values for the Pigmy shrew were accompanied by some of the lowest values for the House sparrow (Table 1). In some sites the Water shrew, *Neomys fodiens* (PENNANT) was a supplementary component in the diet of barn owls in Kujawy (Przedecz — 3.7%, Sompolno — 3.9%, Duninów — 4.9%). More frequently, however, the Water shrew constituted a chance component of the food; it was a constant one in Solec — 5.5% — (Table 1). In the above mentioned stations the more abundant occurrence of the Water shrew was explained by the presence of a lake, wet meadows and peatbogs where this species found the conditions favourable. In every collection the Mole, *Talpa europaea* L. was a chance component of the food of the owls.

Under the conditions of Kujawy all bat species constituted a chance component of the food of owls. Six different species of bat were identified in the 22 collections of pellets (Appendix to Table 1). In pellets from the remaining 7 localities no bat remains were found though traces of their presence were found in most of the investigated church garrets.

In Barn owl pellets from Kowal, remains of the Parti-coloured bat, *Vespertilio murinus* L. were found and a skull of the Barbastelle, *Barbastella barbastellus* (SCHREB.) was also found in the church there; both species are new records for the region.

Among remains of rodents found in the pellets, two species predominated — one periodically commensal with man, the House mouse, and the other, an inhabitant of large open areas, the Common vole; these constituted either the basic or a constant component of the food of owls (Table 1).

In the material from Kujawy the percentage occurrence of the House mouse sometimes exceeded 40% (Aleksandrów Kujawski: 41.4%, Zbrachlin: 42.7%); lowest numbers were recorded in the collections from Solec Kujawski and Kruszwica. Largest numbers of the House mouse were found in the vicinity of Włocławek and Aleksandrów Kujawski. By contrast, materials from the vicinity of Inowrocław (without Gniewkowo) were characterized by the paucity

Table 1. Occurrence of small vertebrates in the diet of the Barn owls from the Kujawy region. Numbers of localities are listed in explanations to Fig. 1

Number of the locality and date of collecting the material (2)	1		2		3		6	
	Aleksan- drów Kujawski		Brześć Kujawski		Bytoń		Duninów nad Wisłą	
	Nov. 9, 1964		Nov. 12, 1964		Nov. 13, 1964		Nov. 12, 1964	
Species (1)	n	%	n	%	n	%	n	%
<i>Amphibia</i>								
<i>Pelobates fuscus</i> LAUR.	61	4.3	—	—	1	0.4	7	1.0
<i>Anura</i> sp.	—	—	—	—	—	—	—	—
<i>Aves</i>								
<i>Passer domesticus</i> (L.)	245	17.2	20	6.2	15	5.6	44	6.6
<i>Passer montanus</i> (L.)	2	0.1	—	—	1	0.4	—	—
<i>Apodiformes & Passeriformes</i> sp.	9	0.7	—	—	1	0.4	3	0.5
<i>Mammalia</i>								
<i>Talpa europaea</i> L.	—	—	—	—	—	—	—	—
<i>Sorex araneus</i> L.	122	8.6	29	8.9	16	5.9	107	16.1
<i>Sorex minutus</i> L.	6	0.4	4	1.2	4	1.5	41	6.1
<i>Neomys fodiens</i> (PENNANT)	11	0.8	1	0.3	3	1.1	33	4.9
<i>Chiroptera</i> sp.	1	0.1	1	0.3	—	—	1	0.2
<i>Rodentia</i>								
<i>Mus musculus</i> L.	590	41.4	88	27.1	91	33.9	166	24.9
<i>Rattus norvegicus</i> (BERK.)	—	—	—	—	—	—	—	—
<i>Micromys minutus</i> (PALL.)	53	3.7	16	4.9	11	4.0	26	3.9
<i>Apodemus agrarius</i> (PALL.)	10	0.7	15	4.6	18	6.7	22	3.3
<i>Apodemus</i> sp.	42	2.9	5	1.5	3	1.1	8	1.2
<i>Apodemus sylvaticus</i> (L.)	1	0.1	—	—	—	—	—	—
<i>Apodemus flavicollis</i> (MELCH.)	5	0.4	2	0.6	—	—	2	0.3
<i>Sylvaemus</i> sp.	14	0.9	8	2.4	7	2.6	18	2.7
<i>Clethrionomys glareolus</i> (SCHREB.)	2	0.1	—	—	—	—	7	1.0
<i>Arvicola terrestris</i> (L.)	—	—	1	0.3	—	—	—	—
<i>Pitymys subterraneus</i> (DE SÉLYS- LONGCH.)	16	1.1	—	—	—	—	—	—
<i>Microtus oeconomus</i> (PALL.)	22	1.5	69	21.3	11	4.0	46	6.9
<i>Microtus agrestis</i> (L.)	—	—	—	—	—	—	—	—
<i>Microtus arvalis</i> (PALL.)	186	13.0	54	16.6	86	32.1	128	19.2
<i>Microtus</i> sp.	28	1.9	11	3.4	—	—	6	0.9
Total (3)	1426	100.0	324	100.0	268	100.0	665	100.0

of this species (Table 1). However, these are fertile fields of black Kujawy, in many respects closely similar to those in neighbouring Wielkopolska, where the Common vole is the more abundant prey species for owls.

In those cases where both the Common vole and the House mouse occurred together in the food composition of the Barn owl there was usually some relationship between them. For instance, where the House mouse was abundant,

7 Gniewkowo		8 Grabie		9 Inowrocław		10 Kłodawa		11 Kłotno		14 Kowal	
Nov. 10, 1964		Nov. 14, 1964		Nov. 10, 1964		Nov. 11, 1964		Nov. 12, 1964		Sept. 9, 1964	
n	%	n	%	n	%	n	%	n	%	n	%
4	0.7	1	0.1	62	9.6	2	0.2	4	1.1	14	1.3
—	—	1	0.1	—	—	—	—	—	—	—	—
50	8.2	99	11.5	69	10.7	268	20.7	19	5.3	184	16.7
—	—	—	—	2	0.3	6	0.4	—	—	3	0.3
8	1.5	7	0.7	18	2.9	10	0.8	2	0.6	14	1.3
1	0.2	—	—	1	0.2	—	—	—	—	1	0.1
61	10.0	232	26.9	37	5.8	14	1.1	110	30.8	99	9.0
13	2.1	28	3.2	1	0.2	—	—	19	5.3	4	0.4
7	1.2	15	1.7	2	0.3	—	—	6	1.7	7	0.6
2	0.3	—	—	2	0.4	—	—	2	0.6	9	0.9
207	34.2	206	23.9	75	11.7	349	26.9	56	15.7	387	35.1
2	0.3	—	—	5	0.8	1	0.1	—	—	—	—
31	5.1	1	0.1	15	2.3	68	5.2	25	7.0	—	—
—	—	17	1.9	6	0.9	44	3.4	9	2.5	31	2.8
16	2.6	20	2.3	15	2.3	63	4.8	3	0.8	5	0.4
—	—	—	—	—	—	—	—	—	—	3	0.3
—	—	—	—	3	0.4	9	0.7	—	—	1	0.1
7	1.2	8	0.9	14	2.2	28	2.1	9	2.5	31	2.8
1	0.2	—	—	1	0.2	—	—	2	0.6	2	0.2
3	0.5	—	—	—	—	—	—	—	—	—	—
—	—	2	0.2	—	—	11	1.0	—	—	—	—
29	4.8	55	6.4	12	1.9	12	1.0	22	6.1	13	1.1
—	—	—	—	—	—	—	—	—	—	—	—
164	27.0	123	14.3	289	45.0	353	27.2	60	16.8	271	24.6
—	—	45	5.2	12	1.9	57	4.4	9	2.5	22	2.0
606	100.0	860	100.0	641	100.0	1295	100.0	357	100.0	1101	100.0

the Common vole was scarce and vice versa, e. g. in Inowrocław *M. musculus* reached only 11.7% of the total prey whilst *M. arvalis* accounted for 45%. In Kruszwica the proportions were 6.9 to 64.0% respectively.

The Root vole, *Microtus oeconomus* (PALL.) was the basic component of the food of the Barn owl in Brześć and Solec Kujawski (21.3 and 25.6%) while in Sompolno and Radojewice it was a constant one — 16.9% and 17.6%

Table 1. Continued — second part

Number of the locality and date of collecting the material (2)	15		17		19		20	
	Kruszwica		Krzywosądz		Lubień Kujawski		Łanięta	
	Nov. 11, 1964	n %	Nov. 10, 1964	n %	Nov. 11, 1964	n %	Nov. 11, 1964	n %
Species (1)								
<i>Amphibia</i>								
<i>Pelobates fuscus</i> LAUR.	—	—	—	—	1	2.6	—	—
<i>Anura</i> sp.	4	0.6	—	—	—	—	—	—
<i>Aves</i>								
<i>Passer domesticus</i> (L.)	5	0.8	1	—	10	26.3	2	3.7
<i>Passer montanus</i> (L.)	—	—	—	—	—	—	—	—
<i>Apodiformes</i> & <i>Passeriformes</i> sp.	3	0.5	—	—	1	2.6	—	—
<i>Mammalia</i>								
<i>Talpa europaea</i> L.	—	—	—	—	—	—	—	—
<i>Sorex araneus</i> L.	51	7.7	3	—	—	—	7	13.2
<i>Sorex minutus</i> L.	5	0.8	—	—	—	—	1	1.9
<i>Neomys fodiens</i> (PENNANT)	3	0.4	—	—	—	—	—	—
<i>Chiroptera</i> sp.	—	—	1	—	—	—	—	—
<i>Rodentia</i>								
<i>Mus musculus</i> L.	46	6.9	5	—	7	18.4	18	33.9
<i>Rattus norvegicus</i> (BERK.)	—	—	—	—	—	—	—	—
<i>Micromys minutus</i> (PALL.)	7	1.0	—	—	—	—	11	20.8
<i>Apodemus agrarius</i> (PALL.)	10	1.5	—	—	2	5.2	1	1.9
<i>Apodemus</i> sp.	20	3.0	—	—	1	2.6	1	1.9
<i>Apodemus sylvaticus</i> (L.)	—	—	—	—	—	—	—	—
<i>Apodemus flavicollis</i> (MELCH.)	—	—	—	—	—	—	—	—
<i>Sylvaemus</i> sp.	21	3.1	—	—	2	5.2	1	1.9
<i>Clethrionomys glareolus</i> (SCHREB.)	1	0.2	—	—	—	—	—	—
<i>Arvicola terrestris</i> (L.)	—	—	—	—	—	—	—	—
<i>Pitymys subterraneus</i> (DE SÉLYS-LONGCH.)	—	—	—	—	—	—	—	—
<i>Microtus oeconomus</i> (PALL.)	58	8.7	1	—	—	—	—	—
<i>Microtus agrestis</i> (L.)	—	—	—	—	—	—	—	—
<i>Microtus arvalis</i> (PALL.)	425	64.0	5	—	14	36.8	11	20.8
<i>Microtus</i> sp.	5	0.8	2	—	—	—	—	—
Total (3)	664	100.0	18	—	38	100.0	53	100.0

respectively. In the other localities it was a supplementary component (Table 1).

The Harvest mouse, *Micromys minutus* (PALL.) also occurred in the diet of owls in Kujawy. It constituted a supplementary and sometimes a constant component, the latter usually recorded in collections from the valley of the Vistula — known for its alluvial soils — and also from the vicinity of Inowrocław. The Field mouse, *Apodemus agrarius* (PALL.) was a supplementary component, but sometimes a constant one in this area as well as in Bytoń (6.7%). Other species, both *Muridae* and *Microtidae*, were chance components more frequently than supplementary ones (Table 1).

21 Murzynko Nov. 14, 1964		24 Piotrków Kujawski Nov. 11, 1964		25 Przedecz Nov. 11, 1964		27 Radojewice Nov. 10, 1964		28 Rojewice Nov. 14, 1964		29 Rojewo Nov. 14, 1964	
n	%	n	%	n	%	n	%	n	%	n	%
—	—	45	10.8	20	1.8	7	3.9	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
14	8.6	48	11.5	90	8.2	5	2.8	4	3.0	8	3.9
1	0.6	2	0.5	1	0.1	1	0.6	—	—	—	—
1	0.6	10	2.3	1	0.1	1	0.6	2	1.6	—	—
—	—	—	—	—	—	—	—	—	—	—	—
4	2.4	60	14.4	162	14.7	47	26.7	35	26.5	101	49.5
—	—	5	1.2	14	1.3	14	7.9	6	4.5	14	6.8
—	—	3	0.7	41	3.7	2	1.1	3	2.3	3	1.5
—	—	2	0.4	4	0.4	3	1.8	1	0.8	1	0.5
37	22.8	122	29.4	461	41.9	15	8.5	19	14.4	27	13.2
—	—	3	0.7	2	0.2	—	—	—	—	—	—
7	4.3	9	2.1	57	5.2	4	2.3	—	—	3	1.5
—	—	11	2.6	41	3.7	3	1.7	3	2.3	—	—
9	5.6	7	1.7	18	1.6	3	1.7	3	2.3	3	1.5
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	1	0.6	—	—	2	0.9
—	—	2	0.5	8	0.7	2	1.1	12	9.0	—	—
1	0.6	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	2	1.1	—	—	—	—
—	—	—	—	—	—	—	—	4	3.0	—	—
5	3.1	4	1.0	44	4.0	31	17.6	6	4.5	8	3.9
—	—	—	—	—	—	—	—	—	—	—	—
83	51.2	76	18.3	111	10.1	32	18.2	33	25.0	28	13.7
—	—	6	1.4	24	2.2	3	1.7	1	0.8	6	2.9
162	100.0	415	100.0	1099	100.0	176	100.0	132	100.0	204	100.0

The Field vole, *Microtus agrestis* (L.) — a species new to Kujawy, was found in pellets from Solec Kujawski.

DISCUSSION

The House mouse was undoubtedly the most abundant species in every pellet collection, gathered both now and earlier from Kujawy (RUPRECHT 1964 and 1971a) and Lubelszczyzna (NIKODEM 1974). Under the conditions

Table 1. Continued — third part

Number of the locality and date of collecting the material (2)	30		31		32		33	
	Sędzin		Siniarzewo		Solec		Solec Kujawski	
Species (1)	Nov. 13, 1964		Nov. 13, 1964		Nov. 12, 1964		Nov. 9, 1964	
	n	%	n	%	n	%	n	%
<i>Amphibia</i>								
<i>Pelobates fuscus</i> LAUR.	11	1.8	—	—	21	3.8	—	—
<i>Anura</i> sp.	1	0.2	—	—	—	—	—	—
<i>Aves</i>								
<i>Passer domesticus</i> (L.)	65	10.8	24	7.7	36	6.6	21	2.9
<i>Passer montanus</i> (L.)	7	1.2	—	—	3	0.5	—	—
<i>Apodiformes</i> & <i>Passeriformes</i> sp.	9	7.0	7	2.2	7	1.3	13	1.6
<i>Mammalia</i>								
<i>Talpa europaea</i> L.	—	—	—	—	—	—	1	0.1
<i>Sorex araneus</i> L.	151	25.2	65	21.0	68	12.4	247	34.0
<i>Sorex minutus</i> L.	7	1.2	8	2.6	3	0.5	9	1.2
<i>Neomys fodiens</i> (PENNANT)	15	2.5	1	0.3	30	5.5	12	1.6
<i>Chiroptera</i> sp.	4	0.7	1	0.3	1	0.2	2	0.2
<i>Rodentia</i>								
<i>Mus musculus</i> L.	121	20.2	54	17.5	133	24.4	25	3.4
<i>Rattus norvegicus</i> (BERK.)	—	—	—	—	1	0.2	1	0.1
<i>Micromys minutus</i> (PALL.)	16	2.7	17	5.5	15	2.7	4	0.6
<i>Apodemus agrarius</i> (PALL.)	2	0.3	—	—	10	1.8	2	0.2
<i>Apodemus</i> sp.	9	1.5	6	1.9	35	6.4	3	0.4
<i>Apodemus sylvaticus</i> (L.)	—	—	—	—	2	0.3	—	—
<i>Apodemus flavicollis</i> (MELCH.)	1	0.2	1	0.3	4	0.7	—	—
<i>Sylvaemus</i> sp.	5	0.8	5	1.6	11	2.0	3	0.4
<i>Clethrionomys glareolus</i> (SCHREB.)	—	—	—	—	—	—	2	0.2
<i>Arvicola terrestris</i> (L.)	—	—	—	—	—	—	5	0.7
<i>Pitymys subterraneus</i> (DE SÉLYS- LONGCH.)	—	—	1	0.3	7	1.3	6	0.8
<i>Microtus oeconomus</i> (PALL.)	63	10.5	10	3.2	13	2.4	186	25.6
<i>Microtus agrestis</i> (L.)	—	—	—	—	—	—	1	0.1
<i>Microtus arvalis</i> (PALL.)	111	18.5	102	33.0	140	25.6	173	23.8
<i>Microtus</i> sp.	—	—	7	2.2	6	1.1	9	1.2
Total (3)	598	100.0	309	100.0	546	100.0	725	100.0

of Lubelszczyzna the House mouse was the most common species in pellets of barn owls irrespective of the season. In Wielkopolska, however, there occurred distinct seasonal fluctuations in the abundance of this rodent species in the diet of *T. alba* with a maximum occurrence in winter months while in other seasons it was replaced by the Common vole and other prey species (CZARNECKI et al. 1955). The occurrence of *M. musculus* in the diet of the Barn owl is more frequent in eastern Europe (SCHMIDT 1973) and in the Mediterranean countries where the percentage of the House mouse in the diet of owls may reach 60-90% (CHEYLAN 1976).

34 Sompolno		35 Szadlowice		36 Straszewo		37 Zakrzewo		38 Zbrachlin		Parts: 1+2+3 Total (3)	
Nov. 11, 1964		Nov. 10, 1964		Nov. 10, 1964		Nov. 10, 1964		Nov. 13, 1964		n %	
n	%	n	%	n	%	n	%	n	%	n	%
—	—	8	0.9	—	—	27	1.1	18	5.0	314	1.9
—	—	—	—	—	—	—	—	—	—	6	0.0
61	9.7	53	5.8	1	—	471	19.9	83	23.3	2015	11.9
—	—	—	—	—	—	22	1.0	2	0.5	53	0.3
1	0.2	4	0.4	—	—	25	1.3	4	1.1	162	1.0
1	0.2	—	—	—	—	—	—	1	0.3	6	0.0
218	34.8	48	5.3	6	—	287	12.1	6	1.7	2393	14.1
19	3.0	11	1.2	—	—	6	0.2	—	—	242	1.4
25	3.9	4	0.4	1	—	26	1.1	2	0.5	256	1.5
2	0.4	1	0.1	1	—	3	0.3	1	0.3	46	0.3
52	8.3	206	22.7	—	—	756	31.9	152	42.7	4471	26.4
—	—	1	0.1	—	—	—	—	—	—	16	0.1
9	1.4	48	5.3	—	—	143	6.0	—	—	596	3.5
11	1.7	12	1.3	—	—	28	1.1	6	1.7	314	1.9
8	1.3	14	1.5	—	—	23	1.0	14	3.9	357	2.1
—	—	—	—	—	—	—	—	2	0.5	8	0.1
—	—	4	0.4	—	—	1	0.1	2	0.5	38	0.2
1	0.2	22	2.4	—	—	20	1.0	2	0.5	261	1.5
1	0.2	2	0.2	—	—	—	—	—	—	22	0.1
—	—	2	0.2	—	—	4	0.1	1	0.3	18	0.1
—	—	3	0.3	—	—	9	0.3	2	0.5	61	0.4
106	16.9	37	4.1	—	—	87	3.6	4	1.1	954	5.6
—	—	—	—	—	—	—	—	—	—	1	0.0
91	14.5	410	45.2	—	—	297	12.5	52	14.6	3908	23.1
19	3.0	17	1.9	—	—	129	5.4	2	0.5	426	2.5
626	100.0	907	100.0	9	—	2364	100.0	356	100.0	16944	100.0

KRZEPTOWSKI (1962) explains the regional differences in the diet of *T. alba* in Poland in terms of different agricultural practices which began at the time of the partitions and are still evident in the Russian and Prussian sectors. In his discussion of the causes of these differences he quotes: "..... the areas he studied had long belonged to the Congress Kingdom of Poland where agriculture was at a very low level, quite contrary to the remaining part of Poznańskie (a territory annexed by Prussia). Results of this division may be found even today. In Słupca and Konin districts there are numerous small farms with scattered buildings which provide suitable conditions for commensal species to exist

Appendix to Table 1. Occurrence of bats as chance components of the food of the Barn owls from the Kujawy region. Numbers corresponding to localities are shown in explanations to Fig. 1

Number of the locality (1) Species (2)	1	2	6	7	9	11	14	17	24	25	27	28	29	30	31	32	33	34	35	36	37	38
<i>Myotis myotis</i> (BORKH.)	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-
<i>Myotis nattereri</i> (KUHL)	-	-	+	-	-	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-
<i>Myotis dasycneme</i> (BOIE)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
<i>Vespertilio murinus</i> L.	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eptesicus serotinus</i> (SCHREB.)	-	-	-	-	+	+	+	-	+	+	+	+	-	+	+	-	-	+	-	+	+	-
<i>Pipistrellus nathusii</i> (KEYS. & BLAS.)	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-
<i>Nyctalus noctula</i> (SCHREB.)	-	-	-	-	+	-	+	-	+	-	-	-	+	-	-	+	-	-	-	-	-	-
<i>Plecotus auritus</i> (L.)	+	-	-	+	-	-	+	+	-	+	+	-	-	+	-	-	-	+	+	-	+	+
<i>Plecotus austriacus</i> FISCHER	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

there. This fact explains the high percentage of the House mouse in the food of the Barn owl in that area". NIKODEM (1974) has stated that the common occurrence of the House mouse in pellets of barn owls in Lubelszczyzna is due to the poor sanitary state of hamlets in that region, which may be favourable for plagues of this rodent species. Therefore it may be stated that the diet of owls depends, to a considerable degree on local conditions, which is explicitly indicated by the results obtained in the present study and in investigations by other authors (SKURATOWICZ 1950; SERAFIŃSKI 1954; CZARNECKI et al. 1955; CZARNECKI 1956; CAIS 1963; KULCZYCKI 1964; RUPRECHT 1964 and 1971a; NIKODEM 1974; SCHMIDT 1973).

The material presented from Kujawy shows that the House mouse is replaced by the Common vole in some localities, particularly in the western areas of black Kujawy. With respect to soil fertility these areas are similar to neighbouring Wielkopolska and other regions of western Poland which are noted for their plaques rodents (SIMM & SKURATOWICZ 1950); large populations of the common vole seem to occur there now as well (CABOŃ-RACZYŃSKA & RUPRECHT 1970 and 1975).

Apart from the commensal species — the House mouse and the House sparrow, in the diet of *T. alba* in Kujawy, a significant part is played by shrews, exemplified by the results of the present study and previous investigations in Europe (SCHMIDT 1973).

The share of young and adult house sparrows in the diet of the Barn owl, analysed on the basis of complete skulls, seems to indicate that this owl, as a predator, is non selective in respect of age. However, it is worth remembering that the ratio of age classes distinguished on the basis of the degree of skull ossification may fluctuate depending on the season and the place of origin (DANILOV 1964; NILES 1973). In the case of the small mammals, authors investigating the age structure of prey populations have obtained different results. Thus, in a local population of *Arvicola terrestris* (L.) from Beskid Niski Mts the percentage of the older age classes represented, was higher than that of younger animals (KULCZYCKI 1964). SAINT GIRONS (1973) has recorded that both the Long-eared owl and the Barn owl do not distinguish between age classes of their prey. However, in a south-African population of *Praomys natalensis* (SMITH) constituting the food of the Barn owl, the percentage of different age groups of this rodent was subject to seasonal fluctuations (DEAN 1973). Similar regularities have been recorded for local populations of *M. arvalis* both during one year and in several-year cycles as well (REISE 1972).

In the light of previous investigations both on the influence of digestive processes on the osteological composition of pellets — minimal in the Barn owl — (RACZYŃSKI & RUPRECHT 1974) and the size of the individual territory, which is about 100 ha in the species (DEMENTJEV 1940), the Barn owl is a valuable aid in ecological and physiographical investigations.

The results of the investigations into the diet of Barn owls from Kujawy

have also enabled the small mammals of that region to be surveyed thoroughly. Previous studies on mammals in Bydgoskie (STRAWIŃSKI 1956) have suggested that the area possesses optimum conditions for small mammals; now this has been shown to be correct (RUPRECHT 1964 and 1971a; RUPRECHT in press).

CONCLUSIONS

1. The diet of the Barn owl in Kujawy differs depending on the type of landscape, quality of soils and the level of agriculture.

2. The percentage of food components is determined by local conditions. Around human hamlets it is characterized by the occurrence of commensal species such as the House mouse and the House sparrow; in open areas, by the Common vole and in forests by shrews.

3. A similar percentage of immature and adult birds in the material of *P. domesticus* in pellets seems to indicate that owls catch these birds without any special preference for age classes.

4. A relatively small individual territory of the Barn owl and a low degree of digestion of skeletal elements of the prey make it an ideal species for use in investigations on the distribution and age structure of populations of small vertebrates.

5. The analysis of barn owl pellets from Kujawy has made it possible to record the occurrence of 25 small mammal species; three of these were new to the region (*Vespertilio murinus* L., *Barbastella barbastellus* (SCHREB.), *Microtus agrestis* (L.)).

6. Inspections of church garrets in Kujawy have shown that since 1964 the Barn owl has been common there. Protection of garrets against jackdaws is the most frequent hindrance preventing owls from finding access to suitable nesting places.

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STRESZCZENIE

[Tytuł: O pokarmie płomykówki, *Tyto alba guttata* (C.L.BR.) z Kujaw]

Analizowano materiał zrzutek płomykówki, zebrany jesienią w roku 1964 z 29 stanowisk zlokalizowanych na Kujawach (rys. 1). Ze zrzutek wypreparowano szczątki kostne 16944 osobników drobnych kręgowców, z których 1,9 % stanowiły płazy (1 gatunek), 13,1 % ptaki (19 gatunków), a 85,0 % drobne ssaki (25 gatunków) — tabela 1 i appendix do tabeli. Spośród ptaków, płomykówki przeciętnie najliczniej odławiały wróbla domowego (11,9 %), zaś w ich pokarmie złożonym ze ssaków najważniejszą rolę odgrywały: *Sorex araneus* (14,1 %), *Microtus arvalis* (23,1 %) oraz *Mus musculus* (26,4 %) — tabela 1. Na przykładzie prób materiału czaszkowego *Passer domesticus*, pochodzącego z czterech różnych miejscowości, stwierdzono występowanie nieuszkodzonych czaszek tego gatunku w podobnym procencie ogólnej ich liczebności w danym zbiorze. Stosunek nieuszkodzonych czaszek ptaków młodych do dorosłych (podzielonych na podstawie stopnia ich ossyfikacji) w przypadku trzech zbiorów był podobny i odpowiadał proporcji 1 : 1 (rys. 2).

Objaśnienia do tabeli i rysunków:

Tabela 1. Udział drobnych kręgowców w składzie pokarmu płomykówki z terenu Kujaw. Numery miejscowości są zestawione w objaśnieniach do rys. 1. (1) — gatunek; (2) — numer miejscowości i data zebrania materiału; (3) — razem.

Appendix do tabeli 1. Udział nietoperzy jako przypadkowego składnika pokarmu płomykówki z Kujaw. Numery odpowiadające miejscowościom są podane w objaśnieniach do rys. 1. (1) — numer miejscowości; (2) — gatunek.

Rysunek 1. Rozmieszczenie kontrolowanych stanowisk płomykówki na Kujawach. Czarne kółeczka — negatywny wynik kontroli, białe — miejsca zebrania zrzutek. Granice regionu według HENNEBERG (1951).

Rysunek 2. Struktura wiekowa nieuszkodzonych czaszek *P. domesticus* z wypluwek, w porównaniu z materiałem uzyskanym z odłowów. (1) — ptaki immaturus do 123 dni życia; (2) — ptaki immaturus 124–186 dni życia; (3) — ptaki adultus powyżej 240 dni życia i starsze; (4) — procent nieuszkodzonych czaszek w zbiorze. Oznaczenia wieku według NERO (1951).

РЕЗЮМЕ

[Заглавие: О пище сипухи, *Tyto alba guttata* (C.L.Br.) с Куявии]

Автор проанализировал материал погадок сипухи, собранный осенью 1964 года с 29 станций локализованных на территории Куявии (рис. 1), и вышрепарировал из них остеологические остатки 16944 особей мелких позвоночных: 1,9% составляли амфибии (один вид), 13,1% птицы (19 видов), а 85,0% мелкие млекопитающие (25 видов) — таблица 1 и аппендикс к таблице. Из птиц сипухи чаще всего в среднем вылавливали домового воробья (11,9%), а в пище состоящей из млекопитающих наиболее существенную роль играли *Sorex araneus* (14,1%), *Microtus arvalis* (23,1%) и *Mus musculus* (26,4%) — таблица 1. На примере проб краниологического материала *Passer domesticus* собранных из четырех разных местностей, автор констатировал одинаковый процент встречаемости неповрежденных черепов по отношению к их общей численности в данном материале. Соотношение неповрежденных черепов молодых птиц к таковому птиц взрослых (разграничение производилось на основании степени оксификации черепов) в случаях трех коллекций было как 1:1 (рис. 2).

Объяснения к таблице и рисункам:

Таблица 1. Присутствие мелких позвоночных в составе пищи сипухи с территории Куявии. Номера местностей приведены в объяснениях к рис. 1. (1) — вид; (2) — номер местности и дата сбора материала; (3) — всего

Аппендикс к таблице 1. Присутствие летучих мышей как случайных компонентов пищи сипухи с Куявии. Номера местностей приведены в объяснениях к рис. 1. (1) — номер местности; (2) — вид.

Рисунок 1. Размещение контрольных станций сипухи с Куявии. Черные кружочки — отрицательный результат контроля, белые — места сбора погадок. Границы региона согласно HENNEBERG (1951).

Рисунок 2. Возрастная структура неповрежденных черепов *P. domesticus* из погадок по сравнению с материалом, полученным путем отлова. (1) — птицы immaturus до 123 дня жизни; (2) — птицы immaturus 124–186 дней жизни; (3) — птицы adultus свыше 240 дней жизни и старше; (4) — процент неповрежденных черепов в коллекции. Определение возраста по NERO (1951).

Wynik 1. Wynik 2. Wynik 3. Wynik 4. Wynik 5. Wynik 6. Wynik 7. Wynik 8. Wynik 9. Wynik 10. Wynik 11. Wynik 12. Wynik 13. Wynik 14. Wynik 15. Wynik 16. Wynik 17. Wynik 18. Wynik 19. Wynik 20. Wynik 21. Wynik 22. Wynik 23. Wynik 24. Wynik 25. Wynik 26. Wynik 27. Wynik 28. Wynik 29. Wynik 30. Wynik 31. Wynik 32. Wynik 33. Wynik 34. Wynik 35. Wynik 36. Wynik 37. Wynik 38. Wynik 39. Wynik 40. Wynik 41. Wynik 42. Wynik 43. Wynik 44. Wynik 45. Wynik 46. Wynik 47. Wynik 48. Wynik 49. Wynik 50. Wynik 51. Wynik 52. Wynik 53. Wynik 54. Wynik 55. Wynik 56. Wynik 57. Wynik 58. Wynik 59. Wynik 60. Wynik 61. Wynik 62. Wynik 63. Wynik 64. Wynik 65. Wynik 66. Wynik 67. Wynik 68. Wynik 69. Wynik 70. Wynik 71. Wynik 72. Wynik 73. Wynik 74. Wynik 75. Wynik 76. Wynik 77. Wynik 78. Wynik 79. Wynik 80. Wynik 81. Wynik 82. Wynik 83. Wynik 84. Wynik 85. Wynik 86. Wynik 87. Wynik 88. Wynik 89. Wynik 90. Wynik 91. Wynik 92. Wynik 93. Wynik 94. Wynik 95. Wynik 96. Wynik 97. Wynik 98. Wynik 99. Wynik 100.

PHIOM

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