

FEEDING ECOLOGY OF TAWNY OWL (*STRIX ALUCO*) IN WIGRY NATIONAL PARK (NORTH EAST POLAND)

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Abstract. In 1989–1991, the feeding ecology of Tawny Owl (*Strix aluco*) was studied in Wigry National Park (NE Poland). Diet composition was investigated by analysis of pellets gathered in stands under roost trees or nest boxes from April to August in 3–5 home ranges each year. In order to assess potential prey, small animals were caught in 28 traps. Small mammals composed 66.5% of prey items and 78.9% of food biomass of Tawny Owl, birds – 8.1% and 13.9%, and frogs – 17.4% and 6.8% of prey and biomass, respectively. The diet was dominated by rodents, mainly bank vole (*Clethrionomys glareolus*) and common vole (*Microtus arvalis*), which together composed 37.0% of prey items and 37.2% of the biomass consumed. Among birds, the most common prey was Song Thrush (*Turdus philomelos*). Slightly preferred prey were field mouse (*Apodemus agrarius*), short-tailed vole (*Microtus agrestis*) and bank vole. One pellet contained 1–11 (mean 2.34 ± 0.09) prey items. Amphibians were the most numerous during May and June.

Key words: diet composition, Tawny Owl, *Strix aluco*, Wigry National Park

INTRODUCTION

Tawny Owl (*Strix aluco*) is the most numerous and the best studied owl in Europe. It inhabits all types of habitats: from primeval forests to anthropogenic areas. The distribution of Tawny Owl extends across Europe to North Africa, Iran and western Siberia. Poland is situated in the central part of the species range (Snow & Perrins 1998; Galeotti 2001; Tomiałojć & Stawarczyk 2003). Tawny Owl is a resident generalist nocturnal raptor. The feeding ecology of Tawny Owl based on analysis of pellets was studied in different parts of its European distribution range (e.g. Kirk 1992; Overskaug *et al.* 1995; Capizzi *et al.* 1998; Petty 1999; Obuch 2003; Balčiauskienė *et al.* 2005, 2006). Papers from Poland documented food from farmland and urban areas (Goszczyński 1977; Goszczyński *et al.* 1993; Zalewski 1994), and from forests (Gramsz 1991; Jędrzejewski *et al.* 1994, 1996; Jędrzejewska & Jędrzejewski 1998, Ruprecht *et al.* 1998; Ruprecht 2002; Żmihorski & Osojca 2006). The most important prey were small mammals, especially rodents, but the list of consumed species included also birds, insects, amphibians and reptiles. The diet composition of Tawny Owl showed clear changes among seasons and habitats caused by differentiability of main and secondary prey resources (Kirk 1992; Goszczyński *et al.* 1993; Jędrzejewska & Jędrzejewski 1998; Galeotti 2001; Balčiauskienė *et al.* 2005, 2006). Study by Jędrzejewski *et*

al. (1994, 1996) and Jędrzejewska and Jędrzejewski (1998) in the Białowieża Forest indicated prey preference of Tawny Owl and its impact on the main prey species and the biomass consumed.

This paper presents 3-year data on the feeding ecology of Tawny Owl in Wigry National Park. Its aims were to estimate diet composition, including differences among seasons, and to assess prey selection based on small mammal censuses.

Study area

Wigry National Park (WNP), located in the Suwałki–Augustów Lakeland of NE Poland (Fig. 1, 53°58'N, 23°–23°15'E) covers 150 km². WNP includes the western part of the extensive Augustów Forest surrounding Lake Wigry. The area is fairly flat. The environment of WNP is characterised by a great diversity. Forests cover 63%, lakes 19% and farmlands 15% of the park area. Forest stands are dominated by pine (*Pinus sylvestris*) (80% of the forest area), spruce (*Picea abies*) (12%), black alder (*Alnus glutinosa*) (3%), birch (*Betula verrucosa*) (3%) and oak (*Quercus robur*) (2%). A forest plantation and a young forest cover 9% of the forested area. Stands, 21–40-years old, account for 24%, 41–60-years old for 16%, 41–60 years old for 18%, and old stands (80–100 years) account for 16%. A forest older than 100 years occupy 17% of the park area. WNP has a continental climate, with the mean annual temperature 6.2°C and a period of snow of about 100 days.

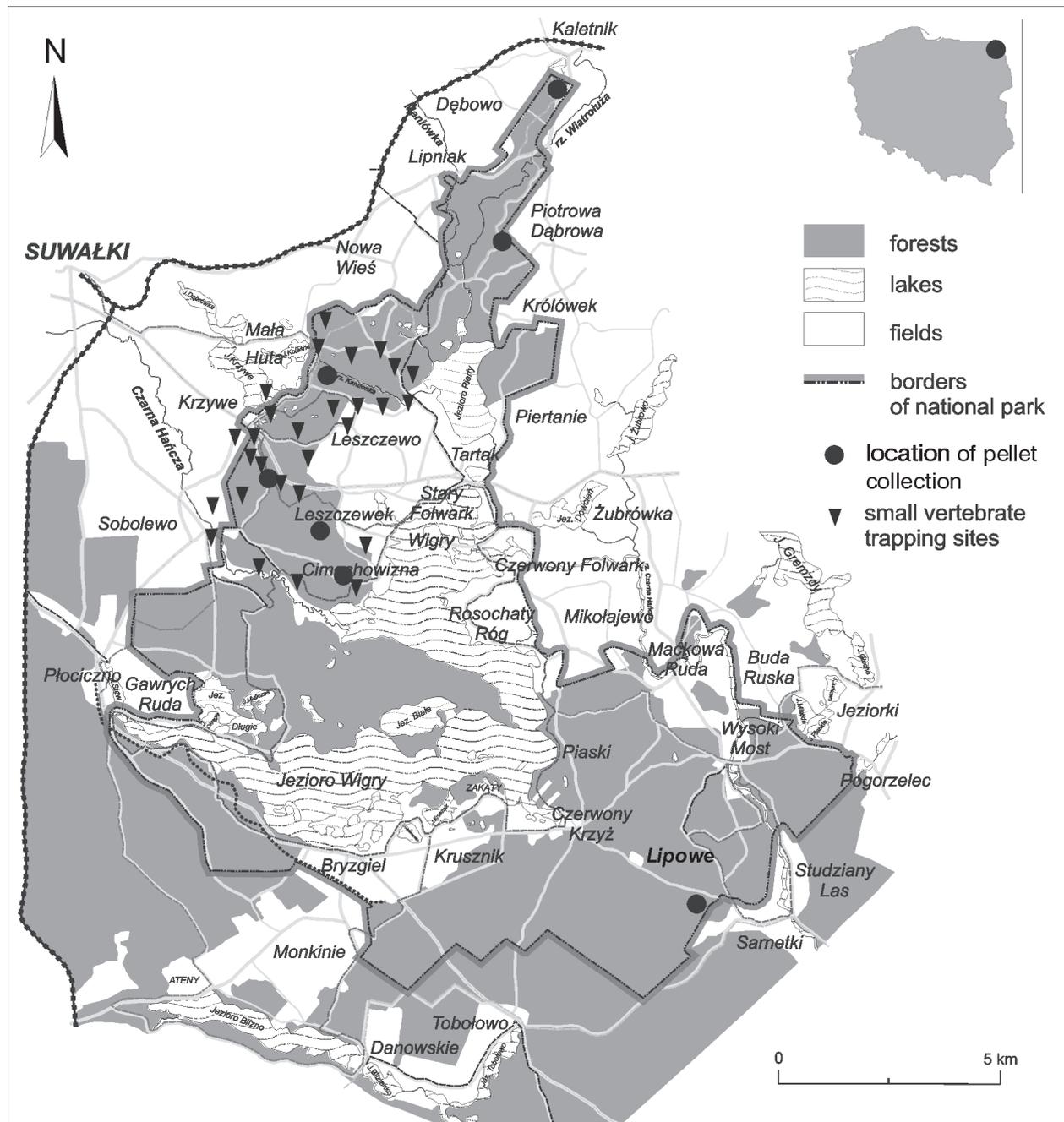


Figure 1. Schematic map of the study area – Wigry National Park in NE Poland.

MATERIAL AND METHODS

In 1989–1991, during the breeding seasons (from April to August), Tawny Owl pellets were collected under roost trees and nest holes in an area of about 15 km² (Fig. 1). The pellets gathered in April contained the remains coming from January to April. In each season, pellets were gathered from 3–5 territories (Zawadzka 2000, 2006). All pellets were collected in tree

stands, 60 to 140 years old, 100–500 m from the forest edge. A total of 348 pellets were found. The number of prey specimens in each pellet was estimated by skeleton remains (Raczyński & Ruprecht 1974). Prey were identified by bone and feather remains according to keys by Pucek (1984), März (1987), and Amann (1995). Diet composition was expressed as percentage of prey specimens and percentage of food biomass. Biomass was calculated by multiplying the number of prey

specimens by the average body mass of a given species (mammals from Pucek 1984 and birds from Busse 1990). The mass of frogs was assumed as 10 g after Berger (2000), whereas that of big insects (Carabidae, Melolontha) as 1 g; mass of small insects was omitted. In total, we analysed 817 prey specimens (211 from 1989, 430 from 1990, and 176 from 1991).

In order to assess potential prey, small animals were caught in 28 traps (jars with formaldehyde) in 1989–1992. The jars were emptied every two weeks, from April to August. The traps were placed in forest stands of all age classes, on the edge of lakes and in fields at a distance to 200 m from the forest edge. Caught species were identified following the keys by Pucek (1984) and Berger (2000). A total of 1,863 specimens were trapped (12 species of mammals, 1 species of reptile and 9 species of amphibians). Mammals accounted for 33% of items.

Prey preference was estimated for rodents, only, by using Ivlev's selectivity index D (modified by Jacobs 1974):

$$D = (r - p) / (r + p - 2rp)$$

where r is a fraction of a given rodent species among all rodents identified in the predator's diet, and p is a fraction of that prey in the living community of rodents. D varies from -1 (complete avoidance) to 1 (maximum positive selection), 0 is random selection (or opportunistic feeding). Undetermined rodents (identified to the genus or family) were distributed proportionally to the species identified.

The G -test for homogeneity of percentages was used to analyse a non-random choice of prey. The assumed null hypothesis was of 1:1 (Sokal & Rohlf 1981). The non-parametric Kolmogorov-Smirnov two-sample test was used to estimate distributions of the number of prey per pellet. D_{KS} was estimated according to Sokal and Rohlf (1981).

RESULTS

There were at least 27 prey species identified from pellets. The most numerous group were mammals – at least 14 species from 3 orders (Insectivora, Rodentia, Carnivora), the next were birds – at least 6 species from 2 orders (Galliformes and Passeriformes). The diet of Tawny Owl consisted mainly of small mammals, which composed 66.5% of prey items and 78.9% of food biomass. Among small rodents, voles dominated and comprised 37.0% of prey items and 37.2% of biomass. The most frequently hunted species of voles were bank vole (*Clethrionomys glareolus*) (11.0%)

and common vole (*Microtus arvalis*) (10.9%). Mice and rats accounted for 10.8% of prey and 19.7% of biomass. Birds accounted for 8.1% of prey and 13.9% of biomass (Table 1). Among birds, the dominant prey was Song Thrush (*Turdus philomelos*). Tits (*Parus* sp.) and Finches (Fringillidae) also occurred in prey. Frogs made up 17.4% of prey items and 6.8% of food biomass (Table 1). Insects played unimportant role in Tawny Owl food. The owls took mainly large beetles (Coleoptera), such as May beetle (*Melolontha melolontha*), and others.

Comparison of the percentage of rodent species in the living community and their share in the Tawny Owl diet indicates that field mouse (*Apodemus agrarius*), short-tailed vole (*Microtus agrestis*) and bank vole are prey of slight preference (but not significantly) (Table 2). Common vole, dominating mainly in the open areas, was taken proportionally to its share. Similarly, yellow-necked mouse (*Apodemus flavicollis*) was caught by Tawny Owl proportionally to its frequency in the living community. Northern birch mouse (*Sicista betulina*) and root vole (*Microtus oeconomus*) were avoided (Table 2).

In the total material, one pellet contained 1–11 (mean 2.34 ± 0.09) prey items (Fig. 2). As much as 39.9% of pellets contained one prey only, 25.6% – two, 14.7% – three, 10.3% – four, and 9.6% of pellets contained 5–11 prey items. The share of pellets with one prey only decreased from 44.2% in late winter to 32.8% in spring and summer (Fig. 2). Differences among seasons were statistically significant for pairs: January–April (mean 2.11) versus July–August (mean 2.58) ($D_{KS} = 0.145$, $p < 0.05$). Mean number of prey per pellet was highest in 1990 (mean 2.74 ± 0.15) smaller in 1989 (2.40 ± 0.17) and the smallest in 1991 (1.69 ± 0.11) ($D_{KS} = 0.219$, $p < 0.05$). Pairwise comparisons between the years revealed statistically significant differences between: 1989 and 1991 ($D_{KS} = 0.239$, $p < 0.05$).

Tawny Owl caught prey of body mass from 1 g to about 400 g. The average body mass of prey was about 25.6 g (mammals – 30.4 g, birds – 44.2 g, frogs – 10 g and insects – 0.61 g).

Seasonal changes in food taken by Tawny Owl were not statistically significant ($G = 1.22$ to 6.47 , $df = 1$, ns, G -test for homogeneity of percentages applied to each prey group, Table 3), although consumption of the main food group slightly changed from late winter till summer. Utilization of rodents was highest in January–April and decreased during May and June. The percentage of caught birds was highest in May–June. Tawny Owl preyed on amphibians most often during May and June (Table 3).

Table 1. Diet composition of Tawny Owl (*Strix aluco*) in Wigry National Park, NE Poland, 1989–1991.

Species	Prey items		Food biomass	
	N	%	g	%
Mole (<i>Talpa europaea</i>)	21	2.6	1,680	8.0
Lesser shrew (<i>Sorex minutus</i>)	11	1.3	77	0.4
Common shrew (<i>Sorex araneus</i>)	38	4.7	342	1.6
Shrews (<i>Sorex</i> sp.)	9	1.1	81	0.4
European water shrew (<i>Neomys fodiens</i>)	2	0.2	30	0.1
Bank vole (<i>Clethrionomys glareolus</i>)	90	11.0	1,800	8.6
Common vole (<i>Microtus arvalis</i>)	89	10.9	1,780	8.5
Short-tailed vole (<i>Microtus agrestis</i>)	17	2.1	578	2.8
Root vole (<i>Microtus oeconomus</i>)	23	2.8	966	4.6
Voles (<i>Microtus</i> sp.)	83	10.2	2,656	12.7
Arvicolidae undetermined	3	0.4	90	0.4
Yellow-necked mouse (<i>Apodemus flavicollis</i>)	21	2.6	630	3.0
Striped field mouse (<i>Apodemus agrarius</i>)	3	0.4	90	0.4
Wood mouse (<i>Apodemus sylvaticus</i>)	4	0.5	120	0.6
Mice (<i>Apodemus</i> sp.)	36	4.4	900	4.3
House mouse (<i>Mus musculus</i>)	12	1.5	240	1.1
Common rat (<i>Rattus norvegicus</i>)	8	1.0	2,000	9.6
Muridae undetermined	10	1.2	250	1.2
Small rodents undetermined	50	6.1	1,500	7.2
Weasel (<i>Mustela nivalis</i>)	2	0.2	170	0.8
Small mammals undetermined	11	1.3	550	2.6
Total mammals	543	66.5	16,500	78.9
Grey Partridge (<i>Perdix perdix</i>)	1	0.1	400	1.9
Song Thrush (<i>Turdus philomelos</i>)	12	1.5	600	2.9
Thrush (<i>Turdus</i> sp.)	2	0.2	120	0.6
Grey Tit (<i>Parus major</i>)	4	0.5	80	0.4
Coal Tit (<i>Parus ater</i>)	1	0.1	10	+
Jay (<i>Garrulus glandarius</i>)	2	0.2	350	1.7
Chaffinch (<i>Fringilla coelebs</i>)	1	0.1	20	0.1
Small birds undetermined	31	3.9	620	3.0
Medium-sized birds undetermined	12	1.5	720	3.4
Total birds	66	8.1	2,920	13.9
Sand Lizard (<i>Lacerta agilis</i>)	2	0.2	40	0.2
Total reptiles	2	0.2	40	0.2
Frog (<i>Rana</i> sp.)	142	17.4	1,420	6.8
Total amphibians	142	17.4	1,420	6.8
May beetle (<i>Melolontha melolontha</i>)	14	1.7	14	0.1
Dor beetle (<i>Geotrupes vernalis</i>)	6	0.7	3	+
Elateridae	4	0.5	2	+
Carabidae	5	0.6	2.5	+
Coleoptera	35	4.3	17.5	0.1
Total insecta	64	7.8	39	0.2
Total	817	100	20,919	100

Table 2. Selection of rodent species by Tawny Owl from the rodent community in WNP, D – Ivlev's selectivity index (Jacobs 1974). Statistically significant non-random choice of prey: ** – $p < 0.01$. G – test for homogeneity of percentages, $df = 1$.

Prey species	Percentage in the rodent community	Percentage among rodents identified from the Tawny Owl diet	D	G
Common vole (<i>Microtus arvalis</i>)	27.3	33.6	0.148	0.656
Root vole (<i>Microtus oeconomus</i>)	24.4	8.7	-0.538	7,754**
Bank vole (<i>Clethrionomys glareolus</i>)	21.8	33.9	0.296	2,649
Northern birch mouse (<i>Sicista betulina</i>)	11.6	0	-1	10,322**
Yellow-necked mouse (<i>Apodemus flavicollis</i>)	11.3	13.0	0.079	0.120
Short-tailed vole (<i>Microtus agrestis</i>)	2.9	6.5	0.390	1,414
Striped field mouse (<i>Apodemus agrarius</i>)	0.7	1.9	0.466	0.136
Other	-	2.4	-	-
Items number	275 (100%)	449 (100%)		

Table 3. Seasonal share of the main prey groups in the Tawny Owl diet (shown as percentage of prey items). Data for 1989–1991 pooled.

Prey group	January–April	May–June	July–August
Insectivores	9.0	13.9	13.2
Rodents	68.1	42.2	50.0
Birds	5.2	12.1	4.7
Amphibians	17.3	28.9	16.1
Number of pellets	207	64	67
Number of prey	423	173	146

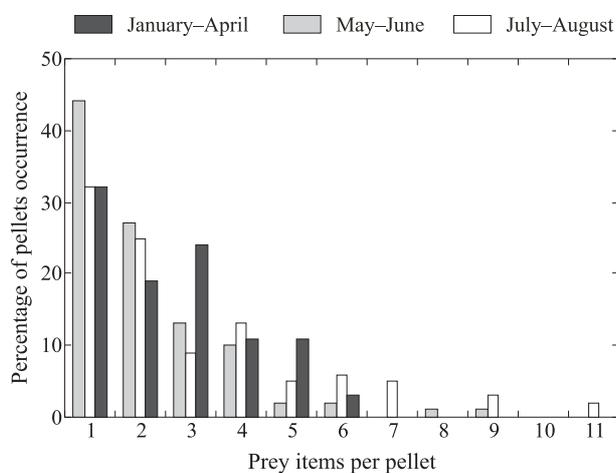


Figure 2. Seasonal distribution of the number of prey items per pellet of Tawny Owls from WNP.

DISCUSSION

The primary prey of Tawny Owl from England to eastern Poland are voles, but their share declines from west to east, while the role of mice grows (review in: Galeotti 2001). Across Poland, the percentage of birds and amphibians increases. Towards the south of Europe, food composition is dominated by mice, bigger mammals and birds (Galeotti 2001). In central and eastern Europe, the diet of Tawny Owl varies in different habitats. In southern Moravia and Slovakia, Obuch (2003), the abundance of frogs and birds in the Tawny Owl diet was reported. The percentage of mammals was strongly variable among the sites, from 17.1% to 74.8%. The most frequent prey among rodents were common vole, harvest mouse (*Micromys minutus*), yellow-necked mouse, bank vole, and field mouse (Obuch 2003). Food of Tawny Owl from the

Notecka Forest (western Poland) consisted mainly of small mammals (21% insectivores, 68% rodents), but also included bats, birds and frogs (Ruprecht *et al.* 1998). In the Białowieża Forest (eastern Poland), small mammals composed almost 65% of prey, whereas birds – 7%, amphibians – 19%, and insects – 10%. The most frequent species were: bank vole, yellow-necked mouse and common shrew (Jędrzejewska & Jędrzejewski 1998). Total biomass was dominated by yellow-necked mouse (22.4%), bank vole (13.5%) and mole (*Talpa europaea*) (10.1%). Birds composed 16.2% of biomass, amphibians – 13.6% (Jędrzejewska & Jędrzejewski 1998). In the Romincka Forest (NE Poland), the diet from one home range of Tawny Owl consisted of 38% of rodents, 34% of amphibians and 17% of insectivores (Żmihorski & Osojca 2006). The most often caught prey were bank voles (15.1%), frogs (*Rana temporaria*) (11.3%) and common shrew (10.7%). In southwestern Lithuania, Šakiai district, the most frequent prey of Tawny Owl during April–May was bank vole, common vole, yellow-necked mouse and common shrew (Balčiauskienė *et al.* 2005). These results are very similar to the data from this study, where the same species dominated in food composition. In Tawny Owl food from Lithuania, the share of birds (13–23% from different years) was higher than in WNP, but lower than that of amphibians (Balčiauskienė *et al.* 2005). Bank vole, common vole, and yellow-necked mouse were the main prey of Tawny Owl in the material from irregularly collected pellets from eight Lithuanian districts. They totally contributed 75% of the biomass consumed. Common vole, yellow-necked mouse, short-tailed vole and common shrew occurred in pellets most often. There were differences in the diet composition among the studied districts (Balčiauskienė *et al.* 2006).

In WNP, Tawny Owl inhabiting forests adjacent to open areas were studied. In our study, the main prey of Tawny Owl were species most numerous in a small mammal community: bank vole, common vole, other voles, mice and common shrew. The share of birds, frogs and insects was slightly lower than in similar studies in central Europe. Our study indicated that species slightly preferred by Tawny Owl were mainly field mouse, short-tailed vole and bank vole. Tawny Owl in the Białowieża Forest preferred yellow-necked mouse, while numerous bank voles were avoided (Jędrzejewska & Jędrzejewski 1998). High levels of consumption of bank voles are reported in all studies on the diet of Tawny Owl in forests of eastern Poland and Lithuania. All papers from that region have also documented a lower consumption of common shrew, despite its rela-

tively high abundance (Jędrzejewska & Jędrzejewski 1998; Balčiauskienė *et al.* 2005, 2006; Żmihorski & Osojca 2006; this study).

Tawny Owl pellets are often used to identify the occurrence of rare species (Balčiauskienė 2005; Żmihorski & Osojca 2006). Species remains found in pellets of Tawny Owl document a greater diversity of the community than the data obtained by trapping (Balčiauskienė 2005). Comparison of the data from WNP (a total of 12 small mammal species in traps) and from pellets (14 species) confirms this pattern.

In other studies, the average number of prey per pellet was 2.1 for captive Tawny Owls and 1.9 for the wild ones in Great Britain (Southern & Lowe 1982). The average number of prey from central Lithuania was 2.95 (data Rumbutis 1982, recalculated by Balčiauskienė *et al.* 2006) and from southwestern Lithuania 2.84 (Balčiauskienė *et al.* 2006). The number of prey per pellet in WNP was similar.

Seasonal differences in catching birds and amphibians found in WNP were similar, but not so clear as those reported in other studies (Kirk 1992; Goszczyński *et al.* 1993; Jędrzejewski *et al.* 1996; Żmihorski & Osojca 2006). Small seasonal differences in consumption of small mammals seem to be caused by the possibility of Tawny Owl preying in both open (non-forested) and forested habitats.

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**NAMINĖS PELĖDOS (*STRIX ALUCO*) MITYBA
VYGRIŲ NACIONALINIAME PARKE
ŠIAURĖS RYTŲ LENKIJoje**

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SANTRAUKA

Tirta naminės pelėdos (*Strix aluco*) mityba Vygrių nacionaliniame parke šiaurės rytų Lenkijoje. Mitybos liekanos buvo renkamos 3–5 pelėdų teritorijose kasmet nuo balandžio iki rugpjūčio mėnesio 1989–1991 metais. Siekiant nustatyti potencialaus grobio (smulkiųjų stuburinių) bendrijos struktūrą, buvo pastatytos 28 gaudyklės smulkiems gyvūnams gaudyti. Smulkūs žinduoliai sudarė 66,5% visų pelėdų sumedžiotų individų ir 78,9%

visos suvartotos biomasės, atitinkamai paukščiai sudarė 8,1% ir 13,9%, o varlės 17,4% ir 6,8%. Naminės pelėdos mityboje dominavo smulkūs graužikai, iš kurių didžiausią dalį sudarė rudasis ir paprastasis pelėnai: 37,0% visų aukų skaičiaus ir 37,2% visos biomasės. Iš paukščių rūšių strazdas giesmininkas (*Turdus philomelos*) buvo dažniausiai sumedžiojamas grobis. Dirvinė pelė (*Apodemus agrarius*), pievinis pelėnas (*Microtus agrestis*) ir rudasis pelėnas (*Clethrionomys glareolus*) buvo dažniau pasirenkamas grobis. Sumedžiotų individų skaičius vienoje atrajoje sudarė 1–11 (vidutiniškai $2,34 \pm 0,09$). Daugiausiai varliagyvių buvo sugauta gegužės ir birželio mėnesiais.

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