

Feeding Ecology of Tengmalm's Owl *Aegolius funereus* in the Šumava National Park, Czechoslovakia

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ABSTRACT

The composition of Tengmalm's Owl's diet in the Šumava National Park (SW Bohemia) in a breeding season was studied from 1984-1991 through analysis of the prey remains from nest boxes. Small mammals comprised the main part of the diet. Food composition showed year-to-year fluctuation, reflecting the changes in small mammal numbers. To clarify the diet's dependence on small mammal population cycles, small mammals were trapped in two Tengmalm's Owl territories from 1988 to 1991. The results indicate that Tengmalm's Owl hunts various small mammals in proportion to their numbers at any given time. *Microtus* voles were the main source of food, but in years when their numbers were low, the most important alternative prey were *Sorex* shrews. Breeding of Tengmalm's Owl was unsuccessful in the year of minimum phase of the *Microtus agrestis* population cycle.

INTRODUCTION

The Šumava National Park in southern Bohemia contains what is probably the largest continuous population of Tengmalm's Owl in all of Czechoslovakia. Šumava is a mountainous region in SW Bohemia, the main ridge of which borders Germany to the west and Austria to the south. These are low mountains with average elevations between 700m and 1,000m and peaks reaching 1,300m. Approximately 70% of the region is covered with forest, particularly with extensive spruce monoculture. Since the 1960s a considerable amount (1,630km²) of Šumava has been protected as a Natural Park, and in 1991 the National Park which, including the transition zone, has the same area, was proclaimed. This report on the feeding ecology of Tengmalm's Owl is the outcome of research in the region conducted over the last ten years.

RESULTS

On the basis of annual spring mappings of displaying Tengmalm's Owl males, carried out since the beginning of the 1980s, it is estimated that there is approximately one Tengmalm's Owl male

for every 3-5 km² of forest. The entire population in Šumava (including the promontory) is estimated at 300-500 territorial males, with 200-300 of them in the protected area. Tengmalm's Owls usually breed in natural cavities in older spruce forests of diverse spacing, often with many clearings and some new plantations. Breeding often occurs also at the forest edge, sometimes in solitary trees up to several hundred metres outside the forest proper. Nest-boxes were introduced at the beginning of the 1980s (there were 8 in 1983 and 80 in 1991), and are occupied at an average frequency of 10.8% of the 295 possibilities.

This research into the species' diet is based on analyses of prey remains taken from the nest-boxes after breeding (see Kloubec & Vacík 1990). These remains provide a representative cross-section of the nestlings' diet during the second half of their time in the nest hole (Korpimäki 1981) and were generally collected under given conditions at the turn of May/June. From one nest 64.5 prey items (SD = 43.2) were identified. The average number of individuals identified in a given year corresponds fairly well with the abundance of small mammals (Fig. 1).

Figure 1. Comparison of number of prey items identified in nests of Tengmalm's Owl and spring trapping indices of small mammals abundance.

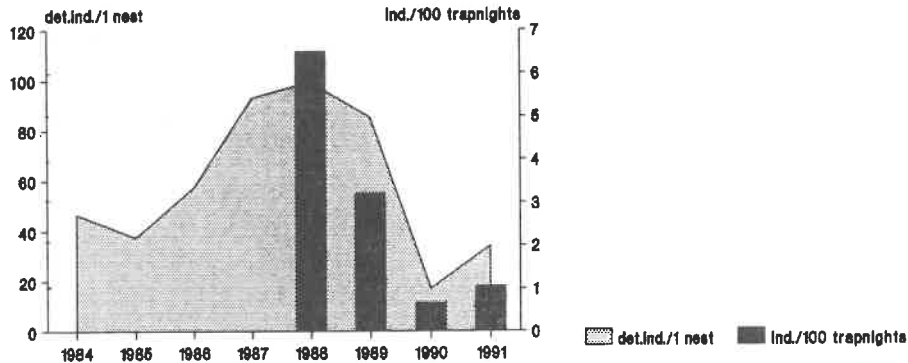


Table 1. Food composition of Tengmalm's Owl at end of the breeding season in the Šumava National Park

Species	Number ind.	Number %	Coef. var.%	Weight %	Collect %
<i>Sorex araneus</i>	499	27.6	91.5	12.6	100.0
<i>Sorex minutus</i>	41	2.3	83.0	0.4	60.7
<i>Neomys fodiens</i>	9	0.5	41.5	0.4	17.9
<i>Neomys anomalus</i>	1	0.1	-	0.0	3.6
<i>Myotis nattereri</i>	1	0.1	-	0.0	3.6
<i>Clethrionomys glareolus</i>	138	7.6	98.0	7.0	67.9
<i>Arvicola terrestris</i>	6	0.3	33.3	1.6	17.9
<i>Pitymys subterraneus</i>	44	2.4	83.9	2.2	39.3
<i>Microtus arvalis</i>	131	7.3	104.9	7.0	75.0
<i>Microtus agrestis</i>	546	30.2	101.3	42.1	96.4
<i>Apodemus flav. + sylv.</i>	190	10.5	93.2	13.5	78.6
<i>Muscardinus avellanarius</i>	79	4.4	83.8	4.3	50.0
<i>Sicista betulina</i>	49	2.7	102.0	1.2	46.4
Σ Mammalia	1,734	96.0	68.3	92.3	100.0
Small birds (to 40 g)	46	2.6	74.7	3.5	60.7
Other birds (over 40 g)	20	1.1	59.2	4.23	5.7
Σ Aves	66	3.7	73.2	7.7	71.4
Σ Insecta	6	0.3	0.0	0.0	17.9
Total %	-	100	-	100	-
Total N	1,806	1,806	1,806	39,523g	28

Table 1 indicates the composition of the owl's diet between 1983 and 1991, according to analyses of prey remains from nest-boxes after 28 breedings in 11 localities. Small mammals comprise the main part of the diet. Small passerines are seldom taken, and the greatest exception is when insects are found among the prey (*Neuroptera*, *Hymenoptera*, *Coleoptera*). Prey with an average weight of 20-35g predominate. Figure 2 shows the considerable difference in Tengmalm's Owl feeding habits from 1984 to 1991. This clearly mirrors the population cycles of small mammals in the region and illustrates the bird's dependence on them.

To clarify the pattern of this dependence we have been catching small mammals each spring and autumn since 1988 in two regularly occupied Tengmalm's Owl territories within 4km of each other. In spring, from the beginning of May to mid-June, small mammals were caught in snap-traps within a 1km radius of the nest hole, i.e. in the territory of the breeding pair (Sonerud, Solheim & Jacobsen 1986). The traps were spread in standard lines (Pelikán 1975) over a variety of terrain: meadows, clearings, young plantations, old forest. The spring captures comprised 4,662 trapnights in total. In autumn, every September or October since 1988, small mammals were caught in two stable quadrats; grassland and forest.

Figure 2. Year-to-year variation of food composition of Tengmalm's Owl at the end of the end of the breeding season in the Šumava National Park.

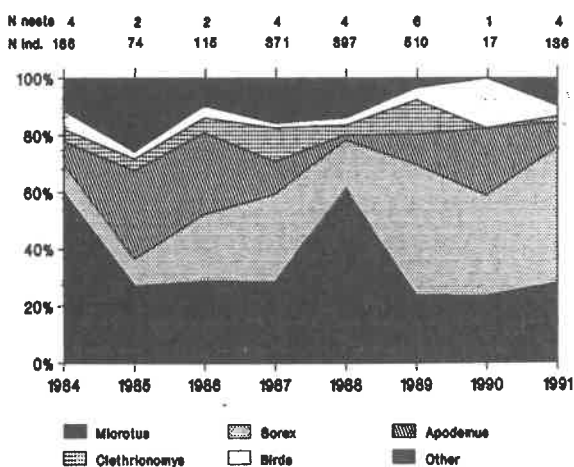


Figure 3 illustrates the frequency of the commonest genera of small mammals from 1988 to 1991, based on captures for every 100 trapnights. *Microtus agrestis* fluctuated cyclically, with its population peaking in 1988 and at a low in 1990. *Sorex* shrews were most numerous in autumn and least so in spring. *Apodemus* mice also fluctuated seasonally, although differing from year to year, while *Clethrionomys* voles remained in low numbers throughout the period. The coefficient of variation was 95.5 for *Microtus agrestis*, 27.2 for *Sorex araneus* and 15.4 for *Sorex minutus* populations.

Figure 4 shows the variation between small mammals caught in two Tengmalm's Owl territories and the prey remains examined in the same territories over the four-year period. The figures are in relative accordance. Differences between the food-base and the food consumed were not statistically significant in Territory 1 in 1988 ($\chi^2 = 3.57$, $P > 0.05$); the same was true for Territory 2 in 1989 ($\chi^2 = 6.03$, $P > 0.05$). There were higher (statistically significant) differences between food-base and food consumed in three other cases, but no species of small mammal was systematically over- or under-represented and none of the variations followed any consistent trend.

These results accordingly indicate that Tengmalm's Owl hunts different small mammals proportionately relative to their numbers in a given area at a given time; no small mammal species is given any preference. Forest species (*Apodemus*, *Clethrionomys*) and meadow species (*Microtus agrestis*) are also proportionately represented in the diet.

When comparing the dynamics of small mammal numbers (Fig.3) with that of the owl's food

Figure 3. Trapping indices for separate genera of small mammals in 1988 - 1991 [S = spring, A = autumn].

(Note: *M. agrestis* represents more than 90% of *Microtus* caught; captures of *M. arvalis* were rather exceptional. Captures of *Sorex araneus* and *S. minutus* showed the same dynamics, therefore their indices are pooled, as well as those of *A. flavicollis* and *A. sylvaticus* for the same reason.

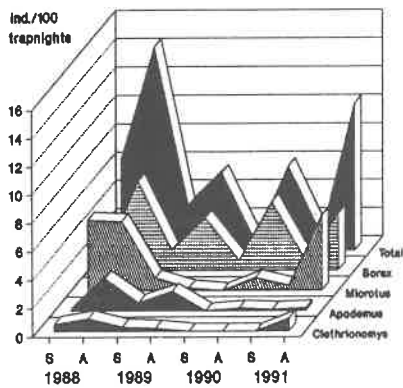
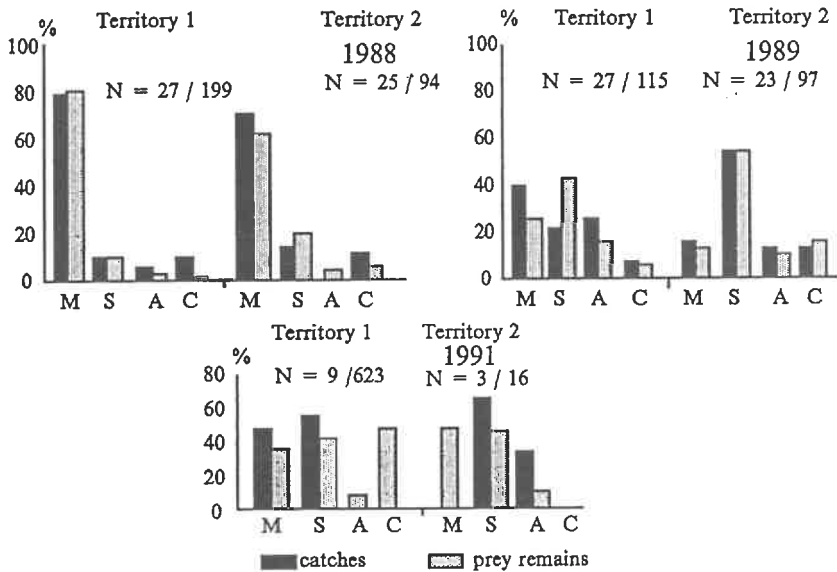


Figure 4. Comparison of the proportion of separate genera of small mammals caught in Tengmalm's Owl territory and the actual food consumed during the breeding season as identified in prey remains for two territories during a period of four years [*M* - *Microtus*, *S* - *Sorex*, *A* - *Apodemus*, *C* - *Clethrionomys*]

(Note: Breeding in both territories was unsuccessful in 1990.)



composition (Fig.2), *Microtus* voles - particularly *M. agrestis* - are clearly the main source of food in relation to their high population density. In peak vole years these comprise up to 90% of the owl's diet. In years when the voles are less numerous they range from 30% to 50%. Next are the *Sorex* shrews, whose numbers do not fluctuate so drastically, followed by a variety of small mammal species according to their availability. Birds are not a considerable alternative prey during the breeding season.

The most notable factor seems to be the number of *Microtus* voles in spring. The critical value

of relative abundance is approximately 0.3 ind. per 100 trapnights. When the number of voles is lower than this, the owls breed unsuccessfully or not at all, as was the case in 1990, when no pairs bred successfully in any one of 74 nest-boxes.

The relation between food-base and diet composition of Tengmalm's Owl in the breeding season was studied by Korpimäki (1988) in western Finland and by Hörnfeldt *et al.* (1990) in northern Sweden. In both studies concerned the authors stated a considerable preference for *Microtus* voles in the diet of Tengmalm's Owl. On the other hand, *Clethrionomys* voles were taken either in proportion to their relative abundance in the field or less than expected from their relative abundance (Korpimäki *loc. cit.*; Hörnfeldt *et al.*, *loc. cit.*). In addition, Korpimäki (*loc. cit.*) stated that birds were important alternative prey: in some poor vole years birds comprised up to 30% of the diet of Tengmalm's Owl.

The differences between these results from Scandinavia and our results from Šumava may have been caused by different availability of small mammals for Tengmalm's Owl. Ground vegetation in spruce forest in Šumava mountains is sparse, so that the availability of prey living in this forest (*Clethrionomys*, *Apodemus*) is consequently higher. On the contrary, *Microtus agrestis* prefers meadows, abandoned for several decades, with tall and dense vegetation cover, and consequently with lower availability of small mammals for owls. *Microtus* voles, however, are supposed to be more profitable prey than *Clethrionomys* or *Sorex*, as they are heavier (Korpimäki *loc. cit.*). Thus one can assume contradictory effects of two substantial factors, affecting the preference of prey by predator, i.e. energetic profitability (size of prey) on the one hand, and the availability of the prey on the other hand. These contradictory effects may have resulted in the situation that, under given conditions, different small mammals are hunted in proportion to their relative abundance in the field.

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