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Lepidopterans in the summer diet of *Eptesicus serotinus* in Central Bohemia

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Abstract. Dismembered prey samples, especially lepidopterans, were collected using fine nets underneath feeding perches around the summer roost of *Eptesicus serotinus* in the Čentice village (Central Bohemia). We evaluated the total number of moths, species composition and dominance of particular species in the diet of *E. serotinus* during the summer season. In total, fragments of 299 individuals of lepidopterans were collected and identified. The most frequently culled parts collected under the feeding perches were *Mamestra brassicae* (40.5%), *Odonestis pruni* (11.7%) and *Noctua pronuba* (10.4%). The most frequent families were Noctuidae (76.7%) and Nymphalidae (6.7%). The overwhelming majority of preyed lepidopterans were tympana moths of cultivated rural habitats. More than 80% of the consumed moths were important agricultural pests.

Foraging, Lepidoptera, serotine bat, Czech Republic

Introduction

Bats belong to animals with mostly nocturnal activity. In the result to such way of life, bats have developed many behavioural and morphological adaptations. Each species has adapted to the given conditions differently, which is also reflected by different morphology of the flight apparatus and type of echolocation (Schnitzler & Henson 1980, Norberg & Rayner 1987, Schnitzler & Kalko 1988). The given parameters are closely connected with the type of prey and predominant hunting strategy.

Eptesicus serotinus (Schreber, 1774) belongs to rather large-sized bat species in the Czech Republic. Similarly to *Nyctalus* or *Plecotus* species, it is mainly an aerial hawker focused on hunting of the flying prey (Gajdošík & Gaisler 2004, Anděra & Horáček 2005). Diet composition of this species in the Czech Republic was studied by Zukal et al. (1997), but in greater detail by Gajdošík & Gaisler (2004). Studies from abroad are available as well (Robinson & Stebbings 1993, Catto et al. 1994, 1996). Diet composition of *E. serotinus* largely varies according to local conditions. In the diet of *E. serotinus*, Andreas et al. (2002) recorded a high proportion of beetles (Coleoptera) in southern Moravia, similarly to pastures in England (Catto et al. 1994), while Gajdošík & Gaisler (2004) found a major proportion of Diptera in the diet of serotines in southern Moravia.

In tropics, diet fragments under bat roosts were collected by LaVal & LaVal (1980a, b), in European conditions partly by Bárta (1975) and Jones (1990). The disadvantage of such methods is that they cannot capture the entire spectrum, especially smaller-sized prey. Wings of small insects could have been eaten directly or they could have fallen off in the moment of capturing the prey (LaVal & LaVal 1980a).

The aim of this work is to find out the composition of particular species of Lepidoptera in *E. serotinus* diet and consequently contribute to the knowledge of foraging ecology of the species.

Material and methods

In the study of diet composition of *Eptesicus serotinus* we focused on the summer season of the year 2012. Observations and surveys showed that three individuals of *E. serotinus* were residing in the examined cavity. The research was carried out in the village of Čentice (49.812° N, 15.092° E), which is located in the eastern part of Central Bohemia at the altitude of 460 m a. s. l. It is a relatively sparsely inhabited area with a mosaic structure. There are several inhabited houses, weekend houses and a couple of cowsheds (not all are being used). The area is formed mostly by farmland, with clover, poppy, wheat, rapeseed and potatoes being the most frequent crops. The rest of the urban area consists of grasslands and forest residues (spruce mostly).

We collected the material single time at the end of the summer season. For the collection of fragments of wings and bodies of Lepidoptera, we used the method of capturing and collecting the material directly under the bat roost (LaVal & LaVal 1980a, b), which was located under a roof of one of the residential houses. Fragments of the prey were captured into fine nets installed right beneath the roost. The nets were exposed for three months during summer (June – July – August). The reason why we adopted this methodology, was the easier and more accurate determination of prey fragments. We determined species composition of the captured Lepidoptera based on wings found; the quantity was evaluated by the number of right/left wings and upper/lower wings. When determining, we used identification keys and atlases of Lepidoptera (Fajčík & Slamka 1996, Fajčík 1998, Nowacki 1998). We tried to determine individual fragments into the lowest possible taxonomical units. The results are qualitatively and quantitatively evaluated (Table 1). Taxa are listed in alphabetical order, followed by their number and total dominance.

Results

In total, we were able to collect 299 specimens of the Lepidoptera order, which were the prey of *E. serotinus* (Table 1). The collected specimens were classified into 30 species. The major proportion was formed by moths (26 species, 87%), however, we also found fragments of Lepidoptera with diurnal activity (4 species, 13%). In the diet, the number of diurnal Lepidoptera was 1.7 % (5 specimens) in the determined samples; moths greatly predominated (294 specimens, 98.3%).

We found three eudominant species – *Mamestra brassicae* was most abundant (40.5%), followed by *Odonestis pruni* (11.7%) and *Noctua pronuba* (10.4%). Significantly dominant species included also *Xestia x-nigrum* (7.7%), *Autographa gamma* (7.0%) and *Noctua comes* (5.7%).

The collected fragments of Lepidoptera belong to seven families (three with diurnal and four with nocturnal activity). The most abundant family was Noctuidae (76.7%), followed by Nymphalidae (6.7%), Lasiocampidae (3.3%), Notodontidae (3.3%), Pieridae (3.3%), Satyridae (3.3%) and Tortricidae (3.3%). Based on the diet analysis there is an obvious significant proportion of agricultural pests (*Agrotis ypsilon*, *Autographa gamma*, *Cydia pomonella*, *Mamestra brassicae*, *Noctua pronuba*, *Odonestis pruni* and *Xestia c-nigrum*). Just these seven most economically harmful species accounted for more than 80% of the total number of collected samples.

The high proportion and importance of Lepidoptera in the diet of *E. serotinus* was documented by the fact that we were able to capture only three members of a different insect group than Lepidoptera into the nets. We determined them as *Chrysoperla carnea* (order Neuroptera).

Discussion

In total, we found 30 different Lepidoptera species in the diet of *Eptesicus serotinus*. The most frequent families were Noctuidae and Nymphalidae. Even though bats go hunting after dark, fragments of diurnal Lepidoptera were also found in their diet. Presence of diurnal Lepidoptera in the diet is probably caused by common roosting of these Lepidoptera with moths under the roof of the residential house, which is to say in immediate vicinity of the *E. serotinus* roost. Unlike in other species of bats (*Myotis daubentonii*, *M. myotis*, *Pipistrellus nathusii* and *P. pygmaeus*), they are just moths which predominate in the diet of aerial hunters such as *E. serotinus*, *Nyctalus*

Table 1. Overview of classified species and families of lepidopterans, their number (n) and dominance (%) in the diet of *Eptesicus serotinus* in the Čentice village (Central Bohemia) in the period June–August 2012

family	species	n	%
Lasiocampidae	*Odonestis pruni*	35	11.71
Noctuidae	*Agrochola macilenta*	1	0.33
	Agrotis ypsilon	8	2.68
	Amphipoea oculea	1	0.33
	Anarta myrtilli	2	0.67
	Autographa gamma	21	7.02
	Brachionycha nubeculosa	3	1.00
	Catocala electa	1	0.33
	Catocala fulminea	1	0.33
	Cucullia umbratica	1	0.33
	Euplexia lucipara	2	0.67
	Euxoa tritici	1	0.33
	Lacanobia thalassina	1	0.33
	Luperina nickerlii	1	0.33
	Melanchra persicariae	2	0.67
	Pachetra sagittigera	2	0.67
	Tholera cespitis	1	0.33
	Trachea atriplicis	8	2.68
	Xestia castanea	1	0.33
	Xestia c-nigrum	23	7.69
	Mamestra brassicae	121	40.47
	Noctua comes	17	5.69
	Noctua fimbriata	7	2.34
	Noctua pronuba	31	10.37
Notodontidae	*Stauropus fagi*	1	0.33
Nymphalidae	*Aglais urticae*	1	0.33
	Vanessa cardui	2	0.67
Pieridae	*Pieris napi*	1	0.33
Satyridae	*Coenonympha arcania*	1	0.33
Tortricidae	*Cydia pomonella*	1	0.33

noctula a *Plecotus auritus*, found together with Diptera and Coleoptera (Bárta 1975, Bauerová 1978, Beck 1995, Andreas 2002, Gajdošík & Gaisler 2004, Anděra & Horáček 2005, Pithartová 2007, Graclik & Wasielewski 2012).

The relatively small distribution of other orders was probably due to the method of collecting the material. The chosen method cannot confidently capture all types of the consumed prey. Practically only larger-sized and firmer parts of bodies are caught, for example Lepidoptera wings and beetle elytra. However, we did not catch any representatives of Coleoptera by the nets, the only exception were three specimens of *C. carnea* (Neuroptera). The absence of hard parts of Coleoptera (elytra, armoured thorax and head) in the sample may indicate a preference of local bats for Lepidoptera and minor Coleoptera that we were not able to catch. A similar methodology used in the study of diet composition of the tropical species *Micronycteris megalotis* has proved to be quite successful in collecting small Coleoptera; in European conditions, however, these results are difficult to reproduce (LaVal & LaVal 1980a). The advantage in hunting Lepidoptera and moths lies in their very high density, relatively high biomass and easy handling when processing unlike the Coleoptera and Diptera orders. An important factor playing role in prey selection was the fact that for most of the hunting time the house lights were on, which attracted a considerable

amount of moths. However, analysis of faeces would be necessary to be able to confirm these preferences unambiguously.

There is an obvious evolutionary effort of the bats to cover echolocation signals from the prey that is sensitive to them (Fullard 1987). There are several ways of hiding them, but the data obtained from the composition of bat diet show little relationship between the amounts of moths equipped with tympanal organ in their diet and the level of customization of echolocation of bats for hunting moths (Miller & Surlykke 2001). Moths with auditory organs are most sensitive to frequencies in the range of 20–50 kHz, which corresponds to the frequency emitted by the studied species (Griffin 1958, Anděra & Horáček 2005). Our results show that exactly moths, though with very sensitive tympanal organs, were the highest percentage of the caught prey. The high number of moths in the diet of *E. serotinus* may be due to localization of the hunting territory in an open habitat without adequate shelters against flying predators. An important role could be played by the presence of artificial light, whilst light blinded moths could only difficultly try to avoid attacks of the bats.

The most commonly caught species of Lepidoptera have very wide habitat preferences. Our findings correspond to the preferred hunting habitat of *E. serotinus* mentioned in the literature (Schober & Grimmberger 1998, Anděra & Horáček 2005). The preferred hunting habitat may vary within the distribution range of *E. serotinus* considerably, which is reflected in the prey choice. According to environmental conditions, Coleoptera and Diptera mostly prevail in the diet, however, along with another important component studied by us – Lepidoptera (Catto et al. 1994, Andreas 2002, Gajdošík & Gaisler 2004).

Bats play an important role in the protection of economically important crops against lepidopteran pests. In our study, pests made up more than 80% of the total composition of the diet of *E. serotinus*.

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