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The diet of the parti-coloured bat Vespertilio murinus in Sweden

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Food habits of the parti-coloured bat in southern Sweden were investigated by analysis of fecal samples collected from three maternity roosts used in summer and, in addition, one roost used by a male during the mating season in autumn. Small (c. 3–10 mm) dipterans dominated all samples, representing 64–82% by volume, but larger flying insects like moths, caddis-flies and dung beetles were also eaten, together representing 14–33%. At the family level, midges (Chironomidae) were by far the most common prey items, comprising 12–67% of the diet. The dominance of small prey items in the diet of the parti-coloured bat in Sweden contrasts with other bat species of similar size and foraging habits, but agrees with observations on parti-coloured bats in Ukraina and Poland.

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Introduction

The 12–20 g parti-coloured bat is distributed from southern Scandinavia and central Europe to the far east (Wallin 1969). In Scandinavia, it is a common bat up to c. 60°N, and probably expanding (Ahlén 1986, Ahlén and Gerell 1990). In summer, females congregate and form maternity colonies, which usually consist of 10–100 individuals. Maternity roosts are usually situated in inaccessible spaces in houses mostly in rural areas (Baagøe 1986, Červený and Bürger 1990).

During the mating season in autumn and winter, parti-coloured bats of both sexes are frequently found roosting in town- and city buildings (Bauer 1954, Spitzenberger 1984, Ahlén 1986, Baagøe 1986). The species is considered a long-distance migrant in eastern Europe (Strelkov 1969), but the frequent occurrence of parti-coloured bats in south Swedish and Danish towns and cities in winter suggests that Scandinavian populations are more stationary (Baagøe 1986). The flight song display of male parti-coloured bats during mild autumn and winter evenings is a well known phenomenon in most towns and cities of southern Scandinavia (Hemmingsen 1922, Ryberg 1947, Kullenberg and Wallin 1963, Ahlén 1986).

Parti-coloured bats often hunt at high elevations over lakes, woodlands and open country, and, in autumn, over illuminated areas (Baagøe 1986, Ahlén 1990). The flight is normally fast and rather straight (Baagøe 1987). The echolocation calls are variable, but those most often heard consist of long, powerful, shallow sweeps that end at 22–26 kHz. Repetition rate is usually rather slow (c. 5 Hz; Ahlén 1981).

There is conflicting evidence regarding the diet of the parti-coloured bat. It has been reported to feed on large insects like beetles and moths (Schober and Grimmberger 1987), but a study from Ukraina (Petrusenko and Sologor 1981) as well as one from Poland (Bauerová and Ruprecht 1989) rather suggests that small dipterans constitute the bulk of the prey. The latter observations are surprising, considering the size and the powerful flight of the parti-coloured bat.

Very little is known about the feeding ecology and diet of the parti-coloured bat in Scandinavia. Hence, the purpose of this study was to examine the food habits of the parti-coloured bat in an area of southern Sweden, where it is common.

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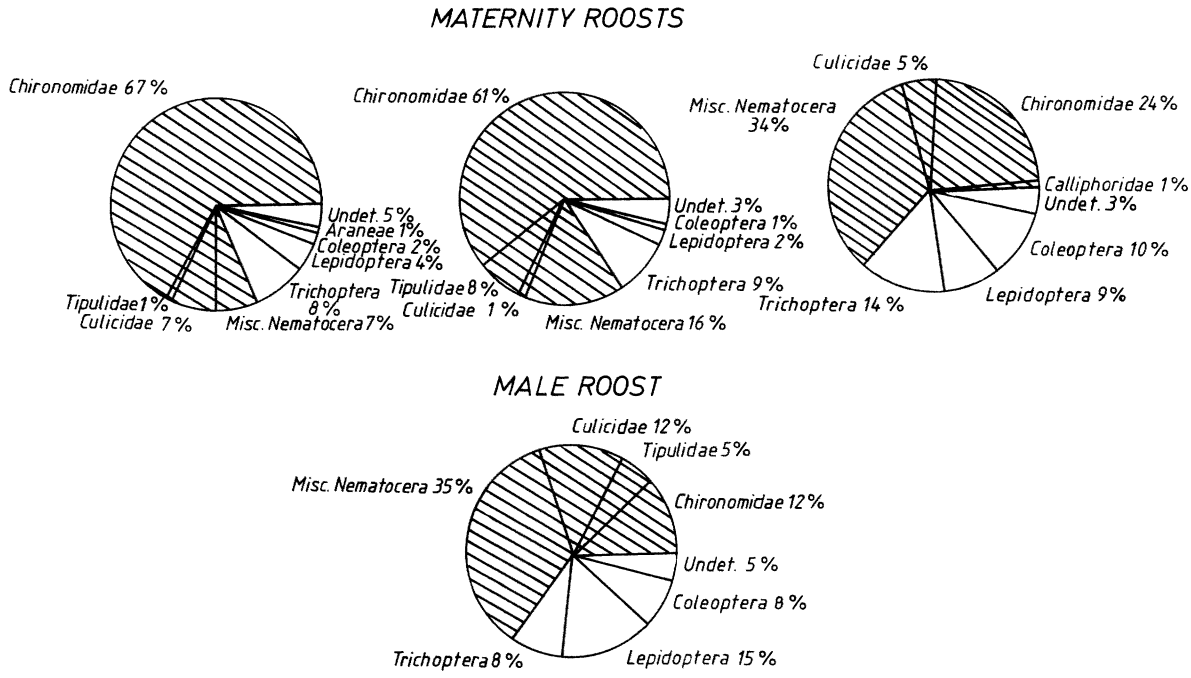

Fig. 1. Percent volume of insect taxa recovered in faeces from three maternity roosts used in summer (June-July), and one male roost used in autumn (Aug.-Oct.), of *Vespertilio murinus* in southern Sweden. The hatched areas represent dipteran taxa.

Materials and methods

Fecal pellets were collected in the roof spaces of three houses in rural areas near the town of Ulricehamn in south Sweden (57°45'N, 13°25'E) in 1985–1988. All three houses were surrounded by farmland and patches of woodland and were located 0.5–1.0 km from lakes. The three houses harboured maternity colonies of particoloured bats in summer (June-July), since young were observed in each of them. Droppings were also collected from a fourth house, situated in the middle of a village, c. 500 m from a river, surrounded by mostly open farmland. This house was used by a male during the mating season in autumn (Aug.–Oct.) in at least two consecutive years. The droppings were collected under the male's roosting site. There was no indication that this house was also used by other bats.

Fifty undamaged droppings from each roost were analysed. They were soaked in water and teased apart under a dissecting microscope. Remains of exoskeletons were compared with whole insects caught in the area, and classified to order, or, in the case of dipterans, to family when possible. For each dropping, the approximate proportions (by volume) representing each taxon were estimated visually. Each dropping was assumed to represent two per cent of the sample, and proportions of each taxon were thus estimated with reference to each bat roost (Rydell 1986, 1989). For an evaluation of fecal anaysis as a method for determining the diet of insectivorous bats, see Rabinowitz and Tuttle (1982), Kunz and Whitaker (1983) and Whitaker (1988).

Results

The most important food items were various kinds of small (c. 3–10 mm body length) dipterans (Nematocera), together representing 64–82% of the diet (Fig. 1). Furthermore, for two of the three maternity colonies, midges (Chironomidae) were by far the most numerous items eaten; this family alone represented as much as 60–67% of the diet. For the third maternity colony, midges were much less dominating, but they still represented 24%. In this colony, other families of small dipterans, including mosquitoes (Culicidae), were most important instead, representing 43%. In all cases, larger prey items were eaten in relatively low numbers; moths (Lepidoptera), beetles (mainly dung beetles; Scarabaeidae) and caddis-flies (Trichoptera), being the most important taxa, together representing 14–33% of the diet.

During the mating season in autumn, the male, like the females in summer, also subsisted on small insects to a large extent, but midges represented only 12% of the diet. Instead, various other families of small dipterans dominated. Small dipterans represented 64% of the diet. The male's diet in autumn was more diverse than

that of the females in summer, and moths were more important (15% as compared to 5%).

With the exception of the remains of one spider (Araneae) and one brachyceran fly (Calliphoridae), there was no evidence that diurnal or non-flying insects were included in the diet at any of the roosts.

Discussion

The results obtained in this study clearly support those from Poland (Bauerová and Ruprecht 1989) and Ukraina (Petrusenko and Sologor 1981), in that the parti-coloured bat's diet is dominated by small flying insects, mainly dipterans (Nematocera). These insects represented 74 and 64% of the prey items (by volume) in Sweden and Poland, respectively. In the polish study, the bats also consumed even smaller insects, like aphids and other "aerial plankton" (c. 5% of the diet). Such insects were not encountered in the present study.

The high importance of small dipterans, particularly midges, as food of the parti-coloured bat during summer agrees with the observation that, as in many other bat species in southern Sweden, feeding frequently takes place near water (Rydell unpubl. data). Indeed, all the four roosts considered were situated near (within 1 km) a lake or a river.

In late summer and autumn, feeding often takes place over street-lights and other illuminated areas (Baagøe 1986, Ahlén 1990). The bats might have been expected to feed less on insects that occur near water during this period, perhaps increasing the utilization of moths attracted to lights instead. This idea is partly supported by the observations. Moths were indeed more important for the male in autumn than for the females in summer. The importance of midges also changed as predicted, although these insects were still eaten in autumn (12%).

The high occurrence of small insects in the diet of the parti-coloured bat seems to suggest that it does not select prey items according to their size (Swift et al. 1985). If so, this is apparently in contrast to other similar sized species that also forage in straight flight in the open air, e.g. the American species *Eptesicus fuscus* and *Lasiurus cinereus*, which often appear to prefer larger insects like moths and beetles (Whitaker 1972, Belwood and Fullard 1984, Barclay 1985, Brigham 1990, Brigham and Saunders 1990). Overrepresentation of large insects may be due to active selection for optimal foraging reasons (Anthony and Kunz 1977, Jones 1990), or may occur because low frequency (20–25 kHz) echolocation calls and high flight speed makes detection and capture of small prey items difficult (Barclay 1985).

The diet of the parti-coloured bat is rather similar to that of the sympatric, slightly smaller (10 g) northern bat (*Eptesicus nilssoni*). In Sweden, both species often feed in the same habitat, using similar flight styles and echolocation calls, although the parti-coloured bat usually flies higher and faster than the northern bat (Rydell 1986, Baagøe 1987). Nevertheless, the northern bat more frequently consumes moths, beetles and other relatively large insects (Rydell 1986, 1989). Perhaps, larger insects are less abundant above tree-top level, where the parti-coloured bat most often forages, than in the vicinity of vegetation, where the northern bat is most frequently observed.

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