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High relative frequency of *Sicista subtilis* (Dipodidae, Rodentia) in owl-pellets collected in Borsodi Mezőség (NE Hungary)

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ABSTRACT: The Southern birch mouse *Sicista subtilis* (Pallas, 1773) is one of the rarest small mammals of Central Europe. Once it was a sporadic species of the Carpathian basin, but today it is endangered, and has disappeared from all but one of its known localities. From the Borsodi Mezőség Landscape Protected Area, 336 remnants of *S. subtilis* among the determined 23200 prey items from *Tyto alba* pellets were detected. This is the only known occurrence world-wide of the subspecies *S. subtilis trizona* (Frivaldszky, 1865) in recent times. The mean frequency of *S. subtilis* in owl-pellets is 2.4% but in 1998 the frequencies were 8.3% (112 specimens) and 27.2% (28 specimens) in two adjacent localities. The apparent decrease in Murinae and *Sorex araneus* in 1997–1998 may partially explain the extremely increase in frequency of *S. subtilis*. The other obvious reason for the high frequency of *S. subtilis* in owl-pellets is the high increase in density on the field, which is well proved by the high frequencies detected parallel on two localities in the same time and by the occurrences on the edge of the protected area where it had not been occurred before.

Introduction

"I do not think I exaggerate when I state that we would find this rare mouse in most parts of the Great Hungarian Plain if we spent more time on its search." This quotation from VÁSÁRHELYI (1929) characterizes the former range of one of the rarest small mammals of Hungary, the Southern birch mouse *Sicista subtilis* (Pallas, 1773). According to VÁSÁRHELYI (1929) *S. subtilis* does not stick to any plant community, but can be found anywhere in the lowlands on alkali as much as on sandy soils. SCHMIDT (1971) and CSERKÉSZ *et al.* (2004) summarized the Hungarian data of the species. The last living specimen was caught in Hungary in 1926 and till 2006 it was detected only from owl-pellets. In 2006, after 80 years, living specimens were found in thistly vegetation *Carduetum acanthoidis* (unpublished data of the author).

Continental occurrences of the species have been reported from Poland (BARANIAK *et al.* 1998), Romania and Bulgaria (AUSLÄNDER *et al.* 1959), Serbia (TVRTKOVIĆ & DŽUKIĆ 1974, HAM *et al.* 1983), Russia and Ukraine (AUSLÄNDER *et al.* 1959, SOKOLOV *et al.* 1987, KOVAL'SKAYA & FEDEROVICH 1997, KOVAL'SKAYA *et al.* 2000). It is extinct in Austria (PUCEK 1999).

The Hungarian Southern birch mouse subspecies *Sicista subtilis trizona* (Frivaldszky, 1865) – differing from other subspecies of *S. subtilis* in phallic morphology (MÉHELY 1913) – is endemic to the Carpathian Basin (CSERKÉSZ *et al.* 2004) and its nomenclature status was clarified by BÁLINT & GUBÁNYI (2006). Today the range of this subspecies has shrunken into only one locality, the Borsodi Mezőség Landscape Protected Area. The results of owl–pellet examinations at this area are presented in recent study, especially the remarkably high frequency of *S. subtilis*.

Material and Methods

The method of analyzing owl pellets is not objectionable from a conservational aspect, and it is a relatively fast way of collecting large amount of occurrence data. The faunistic information provided by these sources of identifiable skeletal remains can be very important because these predators frequently catch mammals which are rarely captured by classic trapping methods (Denys *et al.* 1999). The species composition of prey is related to what is available within the territories of the owls (Mikkola 1982).

Most pellets were collected from *Tyto alba* nesting in church towers (6) and in lofts of farms (16) once in a year. In two places there was opportunity to collect pellets several times every year. The exact number of owl pellets is undetermined because the debris and pellet fragments were also collected, so the number of prey items was used as an indicator of sample size. The pellets were soaked in water and broken up into small fragments manually. Sodium hydroxide solution was used to dissolve the fur/feather matrix and the skeletal material recovered was washed in water and dried. Mammalian prey was identified to species by examination of the skulls and molars (Ujhelyi 1994, Macholán 1996, Demeter & Lázár 1984, Cserkész 2005). In the cases of species of *Sylvaemus* and *Mus* only the subgenus/genus was indicated. For mammalian prey, separate counts for left mandibles, right mandibles and skulls were made for each species, the greatest of these being taken as the number of individuals of the species in the sample.

Relative frequencies were calculated from the number of individuals of the *i*-th species in the sample * 100 / total number of the mammalian prey in the sample.

Study area

Owl pellets were collected from 1994 in the 18 000 ha Borsodi Mezőség Landscape Protected Area (BLPA) within Bükk National Park, North-East Hungary. The area is a very diverse grassland habitat-complex scattered with wet habitats and arable lands, which was created and formed by traditional grazing agriculture in recent centuries. Before the river regulations of Tisza, wetlands were the most characteristic habitats of the region, and residues of these can be still found in great numbers, even today. Floodplain meadows (non alkaline) are characteristic on the southern part. Alkaline meadows are represented by some relict and endangered sodic forest meadows. The most extended plant community of the steppe is the dry alkaline steppe and the most valuable relict spots of the area in floristic and faunistic respect are the patches of loess-steppe grasslands. Other habitats of the region are abandoned plough lands, improved meadows, plough lands, introduced forests, rows of trees and farms.

Fig. 1. The situation of Borsodi Mezőség.

Results & Discussion

In total, the present investigation comprised 23 200 prey items collected from 22 sites since 1994. In BLPA 336 specimens of *S. subtilis* were found on 12 localities. In two places there was opportunity to collect pellets several times every year. One or two specimens were found in every month, the earliest in April and the last in pellets produced in September.

Besides *S. subtilis,* the following species revealed: *Microtus arvalis* (42.4%), *Sorex araneus* (14%), *Mus sp.* 8.7% including: *M. musculus* and *M. spicilegus, Crocidura leucodon* (8.5%), subgenus *Sylvaemus* 6% including: *Apodemus flavicollis, A. sylvaticus* and *A. uralensis (= A. microps), Sorex minutus* (5.5%), *Micromys minutus* (4%), *C. suaveolens* (3,6%)*, Apodemus agrarius* (3.2%), *Sicista subtilis* (2.4%). Less than 1%: *Neomys anomalus, N. fodiens, Myotis blythii, M. dasycneme, M. myotis, M. mystacinus, Pipistrellus pipistrellus, Nyctalus noctula, Eptesicus serotinus, Vespertilio murinus, Cricetus cricetus, Clethrionomys glareolus, Arvicola terrestris, Microtus subterraneus, Rattus sp*. Ratio of species of subgenus *Sylvaemus:* 56.4% *A. uralensis,* 20% *A. sylvaticus,* 17.1% *A. flavicollis,* 6.7% unknown *Sylvaemus* ($N_{Sylva.}$=140). Ratio of species of genus *Mus:* 73.7% *M. spicilegus,* 26.3% *M. musculus* (N_{Mus}=114).

Remains of *S. subtilis* are found regularly but their numbers fluctuate highly. An interesting fact was revealed by the samples collected in 1998 near the city of Mezőcsát (Fig. 2 & 3). In the pellets from two adjacent farms, the relative frequencies of *S. subtilis* were 3.4 times of the average (2.4% › 8.26%) in locality 1, and 11.3 times of the average in locality 2 (2.4% › 27.2%). Species of Crocidurinae and Murinae were almost totally absent in the sample of 1998 in locality 2 (*Crocidura, Mus:* 0%, *Sorex minutus:* 7.7%, *S. araneus:* 2.9%, *Neomys:* 1.9%, *Sylvaemus:* 0.9%, *Microtus arvalis:* 57% and S*icista subtilis:* 27%). Parallel to this increase in frequency, the *S. subtilis* appeared on the edge of the protected area where it had not been occurred before. This case – the "gradation" of *S. subtilis* – is not unique in the related literature. In north Kazakhstan this species may constitute up to 25% of all rodents (Flint 1960). In owl pellets from BLPA it was 11% and 31% of all rodents.

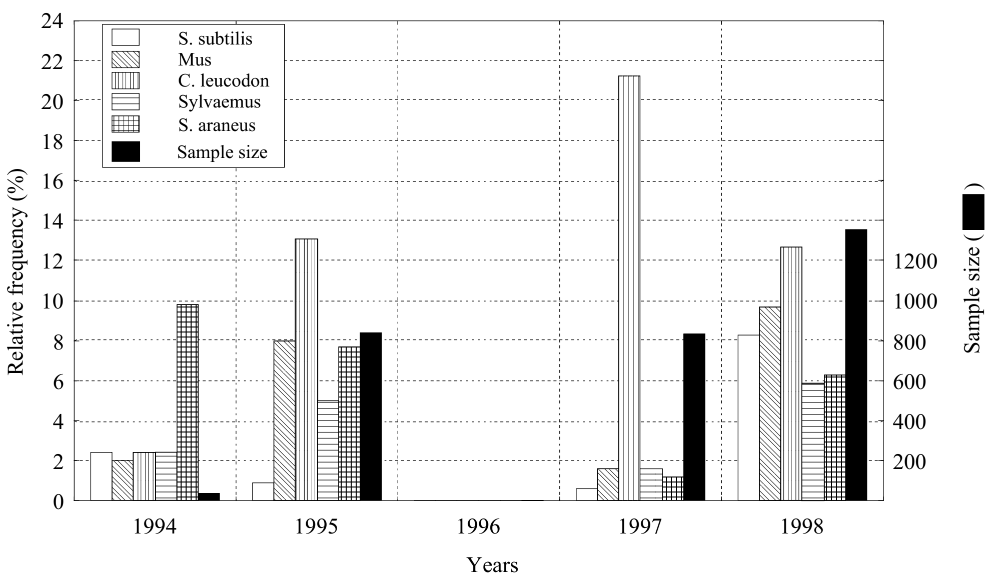

Fig. 2. Annual variation of main prey species in the diet of barn owls in locality 1 between 1994 and 1998. Owls did not occupy the loft in 1996 and 1999.

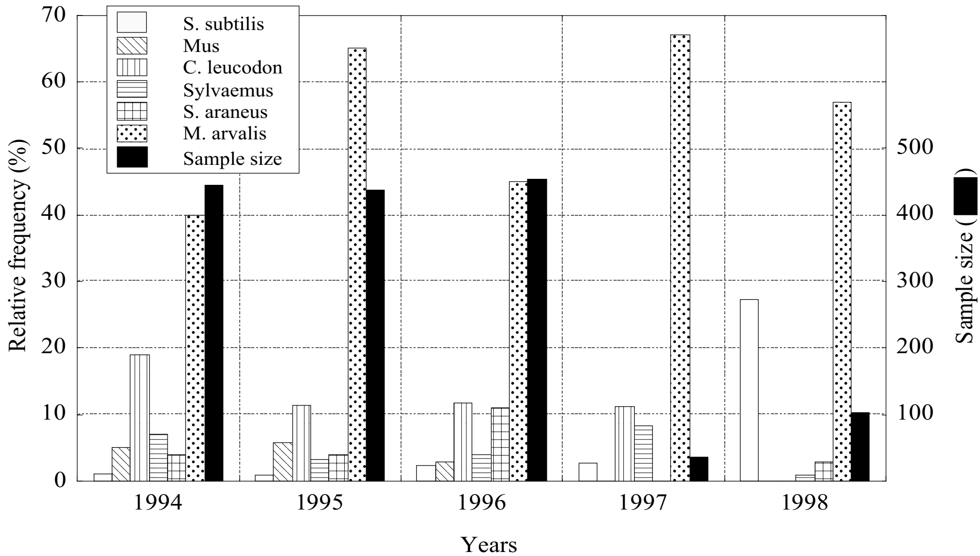

Fig. 3. Annual variation in the diet of barn owls in locality 2 between 1994 and 1998. Owls did not occupy the loft in 1999 and 2000.

Pellet analysis is – under certain conditions – suitable for monitoring changes in abundance. The frequency of a given species in a predator diet depends on several factors. Many of these factors are closely related to the specific prey species, such as its profitability and energetic value, while others relate to external variables, such as the availability of alternative prey, environmental features, season of the year, and, most of all, individual preferences of the predator. The results of study clearly show that the S. *subtilis* has a stable population in BLPA. The diet of *Tyto alba* in BLPA has changed during 1994–2002. These changes are the first indication that the absolute and relative abundance of small mammal species may also have changed. The apparent decrease in Murinae and *Sorex araneus* in 1997–1998 may partially explain the extremely increase in frequency of *S. subtilis*. Species of Murinae with *S. araneus* fluctuated in synchrony in all localities of BLPA, decreasing in 1997 due to an adverse winter, followed by an increase after 1998. This had an effect on the owls that produced the lowest annual rate of reproduction of the decade in 1997 (numerical response). Simultaneously the *S. subtilis* appeared in two localities in relative high frequency. Optimal foraging theory predicts that as main prey abundance declines the predator should take less profitable prey (KREBS & DAVIES 1993). The increase in less energetically profitable species such as *S. subtilis* and *Sorex minutus,* suggests that the overall density of prey has decreased. The other obvious reason for the high frequency of *S. subtilis* in owl-pellets – besides the bottom of the other prey species – is the high increase in density on the field, which is well proved by the high frequencies detected parallel on two localities in the same time and by the occurrences on the edge of the protected area where it had not been occurred before.

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