

Effect of the habitat fragmentation on the structure of small mammal (Rodentia, Insectivora) communities in Kis-Balaton Natural Conservation Area, Hungary

By

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Abstract. Our aim was to demonstrate the differences between small mammal communities in various study areas, which formed same, large, homogeneous habitats previously. The investigation was carried out in the islands of Kis-Balaton Natural Conservation Area, which belongs to Balatonfelvidék National Park. We applied the Capture-Mark-Recapture method to study small mammal fauna. 14 species of Rodentia and Insectivora were detected. Diversity and density of small mammal fauna depend on the size of the fragments and the vegetation structure of the localities. We found the most individuals in large, mosaic-type habitats. The rate of mice, voles and shrews in different study areas strongly differ from each other.

While the ecological role of small mammals has been investigated for a long time by many authors (Batzli, 1975; Flemming, 1975; Golley, 1975), only scarce information is available on the animal communities of large areas, which were broken into fragments earlier. Sometimes, to form an opinion of the small mammals role is very difficult, because the number of individuals can extremely change year by year. Effect of the changing of the population size on the habitat is especially important in those localities, like our study areas.

Well known, that the food preference of rodents depend on the species itself and the supply of food (Hjalten, 1996). The effect of the consumption of plants is very different in a field, a forest, an opened or closed ecosystem etc. This effect is very strong in small islands, which are isolated from their surroundings.

While rodents are mainly plant eater, insectivores feed on smaller animals only, so their role is different from that of rodents. Though, the food supply is not indifferent for them. They prefer their food depending on species (Bellocq, 1994). They are important member of the food chain.

We assumed that the various small mammal species were fragmented into more or less closed populations according to the fragmentation of the previously

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continuous habitat. The isolations went and are going through different events, so the new characteristic features of the populations have been developed as the result of adaptation to the new environmental factors. In the present work, we made a comparison between small mammal communities of such as isolations, which differ from each other in the size and rate of fragmentation.

Sampling sites and methods

The investigation was carried out in two parts of so called "I. cycle" of Kis-Balaton Natural Conservation Area. This place is a large, shallow lake, the reservoir of Zala River, with numerous islands, extended from a few square meters to some hectares. We trapped animals in some islands, on the shore of the reservoir and in a large mosaic-type area, close to the other study areas. The islands stand out about 2 m high from the water. Most of them are degraded habitats. Their vegetation is dominated by weeds, mainly by *Erygeron canadensis*. The smaller habitats are as follows:

I/1. Planted forest in Fekete Island. - It is a large area connected to the mainland by dam. This locality was used as a control to the islands. Dominant trees of the forest are *Populus*, *Betula* and *Sambucus*. This area is bordered on a large reeds and a meadow.

I/2. Small size (1-10 m²) members of the row of islands, situated between Fekete Island and Nagyrada. There are one or two willow (*Salix*) or locust (*Robinia*) trees and bushes (*Sambucus*).

I/3. Medium size (100-300 m²) members of the row of islands. - Vegetation of this area is similar to I/2 study areas, only the number of trees and bushes is larger.

I/4. The largest (about 4 ha) member of the row of island. Dominant plants are *Quercus*, *Populus*, *Betula*, *Robinia*, *Sambucus*, *Crataegus*. Area with an extensive reed belt.

I/5. Dam, at right angles to the row of island. An area of reeds, sedges, grasses and willow trees.

I/6. Shore of the reservoir close to Nagyrada. This is a mainly forested area with reeds.

II. Area for comparison. - Large, mosaic-type area between the reservoir and Zalavár. One part is covered by trees (*Quercus*, *Betulus*, *Fraxinus*, *Populus*) and bushes (*Sambucus*, *Cornus*), the second one by sedges, grasses and weeds (*Erygeron canadensis*). The size of the quadrat was about 1.2 ha.

We applied the Capture-Mark-Recapture method during our investigation. Each of traps was baited by a piece of toast spiced with onion. Distance between two traps was 15 m in study areas I/1, I/4, I/5 and II, and smaller in study areas I/2 and I/3, because of the smaller size of the island, but the number of traps of surface unit was same in every localities. Corn seeds were put into the trap to reduce the mortality. Traps were checked 3-5 times daily depending on the weather and the activity of the animals. Trapped animals were narcotized by diethyl-ether during the treatment. Several parameters of animals, for example length of body, legs and tail, weight, state of sex etc. were recorded. Animals were marked by cut fingers method.

Results and discussion

Altogether, 14 small mammal species were detected (Table 1).

Significant differences were found in terms of population size and diversity among the sites studied. The greatest number of the species and individuals were

found in the extensive study areas II and I/1. Considerably fewer species occurred on the small (I/2) and the medium (I/3) sized islands. Population size were also smaller in these islands compared to the other areas. There was a significant difference in community of small mammals between the small islands and the other areas. To make a comparison among the habitats, the highest similarities were found between the large island (study area I/4) and the close study area I/6. This fact

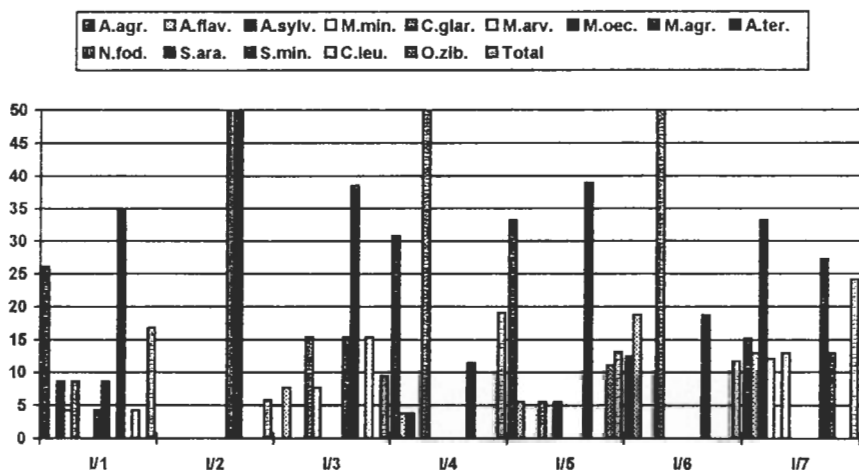


Fig. 1. Rate of the species in different study area

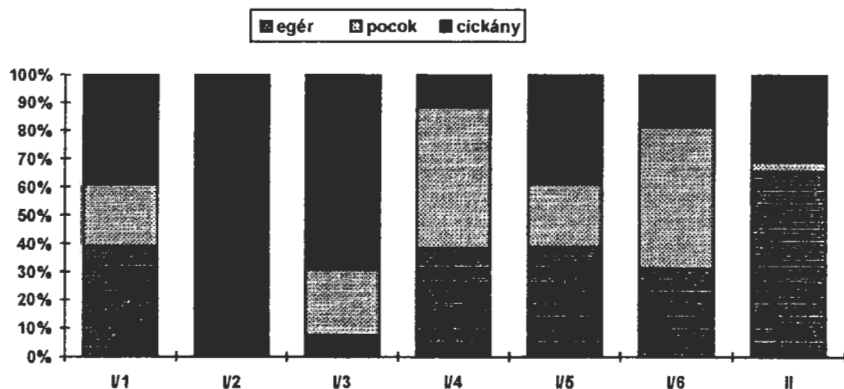


Fig. 2. Rate of mice, voles and shrews in different study areas

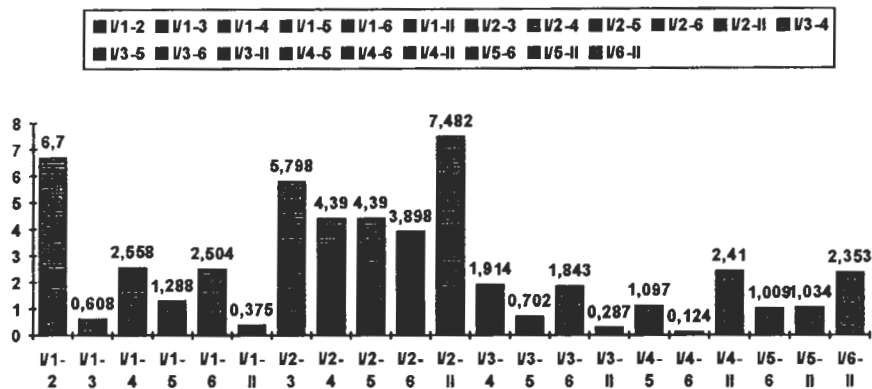


Fig. 3. Differences (t-value) among the study areas

Table 1. Rodentia and Insectivora fauna in study areas

Species	Study area						
	I/1.	I/2.	I/3.	I/4.	I/5.	I/6.	II.
<i>Apodemus agrarius</i> Pallas	+	-	-	+	+	+	+
<i>Apodemus flavicollis</i> Melchior	-	-	+	+	+	+	+
<i>Apodemus sylvaticus</i> Linné	+	-	-	+	-	-	+
<i>Micromys minutus</i> Pallas	+	-	-	-	-	-	+
<i>Clethrionomys glareolus</i> Schreber	+	-	+	+	+	+	-
<i>Microtus arvalis</i> Pallas	-	-	+	-	-	-	+
<i>Microtus oeconomus</i> Pallas	-	-	-	-	+	-	-
<i>Microtus agrestis</i> Linné	+	-	-	-	-	-	-
<i>Arvicola terrestris</i> Linné	+	-	-	-	-	-	-
<i>Neomys fodiens</i> Pennant	-	+	+	-	-	-	-
<i>Sorex araneus</i> Linné	+	+	+	+	+	+	+
<i>Sorex minutus</i> Linné	-	-	-	-	-	-	+
<i>Crociodura leucodon</i> Hermann	+	-	+	-	-	-	-
<i>Ondatra zibethicus</i> Linné	-	-	-	-	+	-	-
Number of species	8	2	6	5	6	4	7

Explanation: - non-existing species, + existing species, I/1.-II. habitats as mentioned in the text

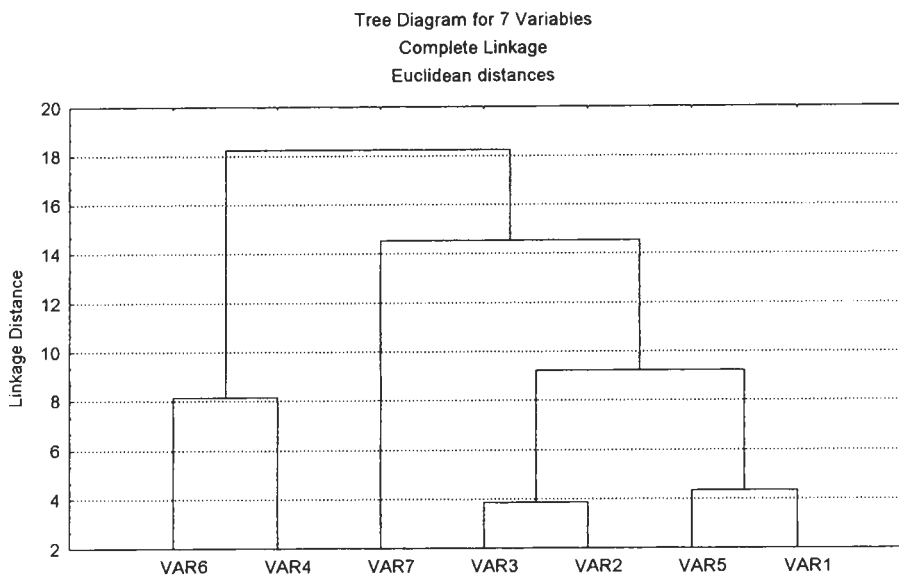


Fig. 4. Results of the cluster analysis. VAR1: study area I/1; VAR2: study area I/2; VAR3: study area I/3; VAR4: study area I/4; VAR5: study area I/5; VAR6: study area I/6; VAR7: study area II

suggests that stable population of several small mammal species can survive on islands of extensive areas. Mice, voles and shrews have different feeding strategies. This is demonstrated in Fig. 2. Only shrews were found on the small islands. Besides water shrews, common shrews were trapped also. Mice and voles feeding mainly on plants could not find food enough in these areas. They had died or migrated away from these areas. On the other hand, insectivores can find food enough for them, because flying insects always migrate to the small islands. On medium sized islands mainly voles occurred beside shrews. Voles feed predominantly on plant materials (e. g. roots, buds) as well as on seeds, whereas mice consume mainly seeds. It is well-known that many rodents collect and store food for winter. This is impossible on small islands due to the limited food sources. The similarity between the large island (study area I/4) and the offshore area of the reservoir (study area I/6) manifests in this respect, too. This similarity may result from two reasons. Firstly, stable populations of small mammals may have survived in the large islands after the area have been flooded. Secondly, there might be migration between the two areas. However, this latter has not been supported by the recent trapping. The proportion of mice is highest in areas covered by trees (study areas II, I/1). The rates of mice, voles and shrews were very similar in study areas I/1 and I/5, which were

close to each other, but represent different types of habitat. It is possible to refer to the fact, that the dams are used by small mammals as ecological corridor.

Data were also analyzed by NuCoSa and Statistic Program packages. Results obtained from cluster analysis suggest the segregation of the mosaic-type study area II and the small islands (study area I/2). The large island (study area I/4) shows similarity to the shore (study area I/6) and the dam (study area I/5).

Finally, we concluded that the small mammal fauna of the small and medium sized islands are very vulnerable. For example, in spite of the former years, on the small islands no mammals were trapped in 1998, and the number of the captured animals in the medium sized island were also smaller. The diversity and density was the highest in the large mosaic-like areas. Dams, joining the fragmentation take part of a very important role as ecological corridors.

REFERENCES

1. BATZLI, G. O. (1975): The role of small mammals in arctic ecosystems. - In: Golley, F.B., Petruszewicz, K. & Ryszkowski: Small mammals: Their productivity and population dynamics. IBP 5. University Press, Cambridge.
2. BELLOCQ, I. & SMITH, S. M. (1994): Arthropods preferred as food by *Sorex cinereus* (masked shrew) and *Peromyscus maniculatus* (deer mouse): An experimental approach. - *Mammalia*, 58: 391-396.
3. FLEMMING, T. H. (1975): The role of small mammals in tropical ecosystems. - Small mammals: Their productivity and population dynamics. IBO 5. Ed: F.B.
4. GOLLEY, F. B., RYSZKOWSKI, L., SOKUR, J. T. (1975): The role of small mammals in temperate forests, grasslands and cultivated fields. - In: Small mammals: Their productivity and population dynamics. IBP 5.
5. HJALTEN, J., DANELL, K. & ERICSON, L. (1996): Food selection by two vole species in relation to plant chemistry. - *Oikos* 76: 181-190.
6. TÓTHMÉRÉSZ, B. (1993): NuCoSA 1.0, Number crunchier for community studies and other ecological applications. - *Abstracta Botanica*, 7: 283-287.
7. TÓTHMÉRÉSZ, B. (1995): Comparative analysis of different methods of diversity orderings. - *Journ. of Veget. Science*, 6: 283-290.