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# Investigation on Small Mammal Communities in the LAJTA Project forest belt system

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## 1. Survey objective:

The author's objective in preparation of the present dissertation:

- full-scale exploration of the small *Rodentia* and *Insectivora* mammal fauna living within the field-protection forest belt system in an intensive agricultural environment.
    - indicating the species living within the area,
    - revealing the species' population characteristics,
    - identification of structural features of the established small mammal communities,
    - recording the changes in structural features over the time,

- clarifying the relationship between the structures of small mammal communities and small mammal habitats,

- Demonstrating the forest belt system's green corridor role in the survival of small mammal metapopulations.

An indirect objective of the dissertation is to investigate the ground-dwelling small mammal fauna, as a part of the long-term habitat investigation of the LAJTA Project – identifying the time-related changes in interactions between the animal species and their intensive agricultural environment.

## 2. Research Area – the LAJTA Project

### 2.1 General Characteristics

The LAJTA Project is located in the NW part of Hungary, within the “Kisalföld” Large Landscape Unit, within the “Mosoni-síkság” Small Landscape Unit – in the southern part, bordering the Hanság Basin – constituting a part of the “Győri-medence” Middle Landscape Unit. Its relief is a high altitude flood area talus plain. Its mean ASL altitude is 120 m. Geologically, the area is the southern slope of the Danube talus built into the sinking basin of the Kisalföld. Its surface is covered by contemporary fluvial silt and gravel as well as by slit-loess sediment. Its climate is moderately cool and dry. A June and an October maximum is characteristic to the rainfall distribution, the rainfall amount is around 500 mm. From hydrological aspect, the investigated area is poor in waters with no flowing water, only two minor lakes are found in the area. The area is characterised by black soils.

The Project is a specific intensive agricultural environment, typically with plough-land cultivation, producing mainly spiciferous plants, corn, cannabis and colza. Forest belts separate agricultural fields from each other. The average field area is 52 ha which can be considered very advantageous from game management aspects – taking into consideration the presence of the forest belts as well. There is no larger contiguous forest, the planned 54 forest fractions are present in the form of forest belts, their total area being about 110 ha.

**2. 2. Characterisation of the Investigated Small Mammal Habitats**

An investigation by trapping has been carried out in a robinia forest spot, in 5 agricultural fields and in the weed belt at their margin.

Forest belts were selected in such way that they represented all belt types present within the area. Consequently, there are well-closed belts with dense shrub level, and single-tree-species, thinned-out belts with homogenous grass. The Robinia, ash (*Fraxinus americana)*, maple (*Acer platanoides and A. pseudoplatanus*) are the determinant tree species. Shrubs are mainly composed of *Ligustrum vulgare, Elaeagnus angustifolia, Amorpha fruticosa* and *Rosa canina.* Dominant herbs in grasses are the *Galium aparine, Agrostis tenuis, Bromus sterilis, Agropyron repens* and the *Dactylis glomerata.*

The 5 studied cultures were the fodder lucerne, triticale, winter wheat, maize and pea stubble-field.

Weed belts' characteristic herb species were the *Agropyron repens, Lolium perenne, Cirsium vulgare, Poa pratensis,* and *Erigeron canadensis.*

# 3. Methods

### 3. 1. Data Collection Methods

The author, during 6 years between 1992 and 1999 has examined by the trapping method the small mammal fauna of the area. In the first two years, the withdraw trapping (traditional mousetraps), later on wooden traps for live trapping were used. In the survey carried out in the forest belts, traps were installed according to the belt transect, at 10 m distance from each other, for 3 trapping nights, a total of 50 traps in each forest belt. In live trapping, both no-marking and Capture-Mark-Recapture (CMR) techniques were used. In 1999 the small mammal community of forest belts and the neighbouring cultures were studied in August, September and October, with 4 trapping-nights by square method (7 x 7 traps).

In data collection, the capture place, species, age, sex and weight of captured animals were registered. Animals collected by withdraw trapping underwent a biometrical data registration (body length, ear length, tail length, hind legs' length).

In description of small mammal habitats, the results of the method locally developed formerly for registering the habitat characteristics for bird communities was used; in case of habitats assessed by square method, this has been supplemented with the shrub and grass levels' detailed species coverage (A-D%) assessment.

### 3. 2. Data Processing Methods

In population-level surveys the following characteristics were determined for each species:

- Populations' biometrical characteristics: mean values of body dimensions, deviation and confidence interval, minimum and maximum values.
- Microhabitat use: Comparison of microhabitat capture data by $\chi^2$-probe
- Changes in sex proportion within a breeding season: sex proportion changes [lg(male/female)] comparison in pairs by correlation, significance test by t-test.
- Dynamics of captured specimen number within a breeding season, per quadrates. In case of the four quadrates examined in 1999, comparison the specimen number values in each month, by variance analysis (one-way ANOVA), significance test by TUKEY HSD test.
- Comparison of the quadrates according to the captured specimen number, within a month: Comparison of the four examined quadrates according to the specimen number captured over a month, by variance analysis (one-way ANOVA), significance test by TUKEY HSD test.
- Changes of the recapturing rate within a vegetation period.

- Capture-recapture events' spatial changes: determination per quadrates the mean vector components of animals' movement, demonstrating the characteristic movement direction.
- Specimen number dynamics for 100 trapping nights between 1992 and 1999.
- Spatial pattern of the population's specimens: analysis by the LLOYD method (Index of Mean Crowding = IMC)
- Changes of mean body weight over the years: comparison over the years by variance analysis (one-way ANOVA), significance test by TUKEY HSD test.

In community-level surveys, the species number, specimen density, dominance relations, diversity and uniformity of the habitats per trapping periods were compared. In diversity comparison, t-test in pairs has been carried out, and the Rényi diversity sorting for scale-dependent characterisation and species abundance curves were applied.

Investigation on the relationship between communities and habitat structures has been carried out by cluster analysis. Fusion strategy has been provided by the deviation square sum increment minimization method, the applied similarity formula being the Euclidean distance method.

For measurement of small mammal community and vegetation mosaicism the Whittaker β-diversity has been used.

## 4. Research Results

### 4.1. Small Mammal Fauna Species and Population Features

During 11,202 trapping nights, within the 24 examined forest belts, 11 ground-dwelling insectivore and rodent small mammal species could be demonstrated, represented by a total of 1645 specimens. The dominant species of the area is the *Apodemus sylvaticus* (36,72%); among the subdominant species, the most frequent is the *Microtus arvalis*, living in open areas (27,23%), however, the occurrence of the *Apodemus flavicollis* (20,67%) and *Clethrionomys glareolus* (10,76%) – being characteristic to the deciduous forests – is also significant. The rare species include *Sorex araneus* (2,49%), *Sorex minutus* (0,67%), *Crocidura leucodon* (0,55%), *Mus spicilegus* (0,43%), *Micromys minutus* (0,36%), *Pitymys subterraneus* (0,06%) and *Cricetus cricetus* (0,06%).

With a view to the dispersion and habitat use, it can be stated that the *A. sylvaticus* is present in 96% of the forest belts, the occurrence of the *A. flavicollis* has a 91%, *M. arvalis* 83% and the *C. glareolus* 74%. The order is the same in the aspects of the microhabitat use: the *A. sylvaticus* had the widest range (100%), the other *Apodemus* species used 74% of the microhabitats while the *M. arvalis* used 52%. It can be stated on all three species that their distribution between the microhabitats is not uniform: the *A. sylvaticus* preferred the habitats that can be characterised by fodder lucerne, *Lolium perenne,* and *Erigeron canadensis*, while it could be demonstrated with least density in the homogenous lucerne culture. One-fifth of the captured *A. flavicollis* has been captured from habitats that can be characterised by closed robinia forests, in grasses including *Amorpha fruticosa*, *Poa pratensis, Bromus* *sterilis,* and *Lamium purpureum*, and no specimens could be captured in the homogenous lucerne culture, maize and harrowed pea stubble-fields. The microhabitat preferred by the *M. arvalis,* included *Agropyron repens, Lolium perenne, Cirsium vulgare and Erigeron canadensis* and no specimen could be captured from the homogenous maize and harrowed pea stubble-fields. On the margin of the closed robinia forest, only one specimen has been captured. The low capture number of the *C. glareolus* in 1999 did not enable this examination, however, there is no doubt that owing to its most infrequent occurrence among the four species, this species uses the most narrow spectrum of the agricultural area with forest belt habitats.

The sex proportions and its changes showed in the full examination period a male majority in all four dominant species, reaching the largest values in case of the voles (*M. arvalis* 76%, *C. glareolus* 71%). In the robinia forest studied with 3F quadrate, the sex proportions of the two *Apodemus* species were just the opposite; the possible reason for this could be that the reproduction cycles of the two species are shifted against each other therefore the synchronised growth within the population occurred in different periods in the two species.

Regarding the population dynamics within the breeding season it can be seen that the population of the two *Apodemus* species, between 1999 July and September, showed an August or September maximum. During the examination of annual dynamics, an opposite direction of population growth could be experienced, which coincides with the results given by the examinations carried out on sex proportion changes. The populations of *C. glareolus* collapsed by the mid-period of the study, their population growth could not be registered later too. The gradation fluctuation of *M. arvalis* occurring in every second or third year has been confirmed according to those experienced within the area.

According to the Lloyd's Patchiness index it can be stated that the majority of wood mouse species' populations exhibited an aggregation while in voles species the populations exhibiting segregation were in majority (8 and 4 cases). The density-correlation of the patchiness could not be demonstrated in any of the species.

The maximum of mean body weight in the two wood mouse species was in 1997 while in the case of voles this was in 1999.

### 4. 2. Comparison of the Small Mammal Community Structures

Species number and the specimen number per 100 trapping nights of the examined small mammal communities showed the maximum values in 1992 and 1999 while the minimum was in 1993 and 1996. Small mammal species composition of the forest belts exhibited significant changes over the years. In 7 out of the total examined 13 forest belts (Mosonszolnok 3I, 4C, Jánossomorja 68C, 69B, 69C, 69F, 70A), the presence of the same three species could always be demonstrated.

Specimen number per 100 trapping nights was the highest (43.33) in 1992, in the forest belt marked 3I, the minimum was in 1993, in the robinia forest (0.67). It should be emphasised the species composition stability and specimen number maximum of the forest belt Mosonszolnok 3I which, according to the author's opinion is a result of an optimal vegetation structure.

Regarding dominance relations, the examined period resulted in the increase of first of all the *A. sylvaticus* population. At the end of the period, in 9 out of 14 forest belts, this species became dominant. Beside this, mostly the *M. arvalis* population could gain strength; in 4 forest belts out of 14, as well as in the robinia forest marked “3F” the *A. flavicollis* became dominant by the end of the period.

Results of examinations carried out within a vegetation period, in the robinia forest “3F”, show that in deciduous forests where the *M. arvalis* isn’t a characteristic member of the small mammal community, the competition of the two wood mice is performed with the same strength like in the open areas between the *M. arvalis* and *A. sylvaticus.*

The small mammal community with largest diversity was in the “69F” forest belt in July 1992 (1.6135), while the area with least diversity was the area marked “3F” in September 1999 (0.4702). The communities showed above-average diversities in 1992. The maximum of the uniformity was exhibited in the forest belt “69C”, in 1992 (0.9952), its minimum being in September 1999, in the area “3F” (0.428).

### 4. 3. Relationship Between Community and Habitat Structures

Forest belts’ small mammal communities and habitats’ vegetation structures have been compared in each trapping periods. If the forest belt pairs got next to each other more often over several examination periods, the similarity between them has been considered stronger.

As a result, the similarity in4 periods of the pair “4C”-“3G” , and the similarity in 2 periods of the pairs “3F”-“4C” and “70B”-“4A” were provided. In these habitat pairs, by comparing them with different habitats over several periods, a similar small mammal community and at the same time a similar vegetation structure could be demonstrated. A similar trend has been found in the Whittaker's β diversity values too. The larger the habitat mosaicism, the less uniform is the distribution of the species number of the small mammal community.

### 4. 4. Forest Belt System's Green Corridor Role in the Survival of Small Mammal Metapopulations

Owing to the fragmentation, the examined LAJTA-Project area has fully transformed into a space, a matrix between natural habitat isles, the only remnants of the one-time natural vegetation are the field protecting forest belts. The author proved that forest belts, with a view to the factors influencing the survival of the small mammal metapopulations of the area: habitats' quality, size, distance and the quality of the matrix between them, are:

- able to ensure the living space for forest small mammal species since the constituent trees and shrubs provide adequate food and microclimatic conditions,
- regarding their dimensions, for small forest mammals the forest belts are less advantageous than the robinia forest patch (3F) since the belts are so narrow (10-30m) that the small forest mammals can find their habitats only if there was more canopy and shrub level.
- There is a species exchange between the forest belts in each year, therefore these are not only stable habitats for the small forest mammals but they provide an ecological ("green")

corridor function, ensuring the connection between the small mammal habitat patches.

- Agricultural cultures are less advantageous for the small mammals than the forest belts. The small mammal communities inside the forest belts show a higher species number, density and diversity than the agricultural fields.

## 5. Scientific Results Summary

- It has been proved that within field protecting forest belts in agricultural areas, beyond the generally widespread rodent species and communities (*Microtus arvalis, Cricetus cricetus*), the three generalist rodent species of the European temperate zone form a stable population *(Apodemus sylvaticus, Apodemus flavicollis, Clethryonomis glareolus)*, owing to which, special, transitional small mammal communities are forming. Within the communities, the dominance of the common wood mouse is characteristic. Most often the common vole is the competitor, while in the forest patches this is the *Apodemus flavicollis*.
- The author has demonstrated that the Apodemus flavicollis is strongly bound to the tree vegetation, as opposed to the Apodemus sylvaticus that is also widespread in agricultural areas with cultivated steppe character too.
- It has been demonstrated that in the area of the robinia patch, during three summer and autumn months the sex proportion of the two Apodemus species is changing in opposite direction, which is a result of competition of species using the same resources and is characteristic to stable communities. Similarly, in the area of the forest belts, the above two species' quantity relations are also changing oppositely, as a result of the competition conditions.

- It has been demonstrated that the mouse (Muridae) and vole species (Arvicolidae) populations' mean body weight values have reached their maximum in different years, which refers to different food resource utilisation.
- Several neighbouring habitats of similar structure and with similar small mammal communities prove that there is a connection between the vegetation structure and small mammal communities; this has also been proved by the mosaicism examinations.
- It has been proved that from the inside of the forest belts toward the agricultural cultures the species number and diversity of the small mammal populations decrease (exponentially and linearly, respectively) and at the same time these features did not show trend-like changes in the robinia forest patch.
- During the examination on the species composition rearrangement it has been proved that the small forest mammal species would not be able to colonize the isle-like forest patches in agricultural areas without the ecological corridor role of the field protecting forest belts.

# 6. Publications Connected to Essay's Topic

## 6. 1. Supervised Press Articles and Independent Publications

NÉMETH, CS. (1997): Kisemlős közösségek vizsgálata a LAJTA-Project erdősávrendszerében. - Magyar Apróvad Közlemények 1: 197-217.

NÉMETH, CS. (2000): Kisemlős közösségek szerkezetének vizsgálata a LAJTA-Project erdősávrendszerében. – Ornis Hungarica 10: 243-253.

## 6. 2. Conference Lectures

NÉMETH, CS. (1994): Kisemlős vizsgálatok a LAJTA-Project erdősávrendszerében. - IV. Országos Környezettudományi Diákkonferencia, Budapest

NÉMETH, CS. (1999): Zöld folyosók a kisemlős védelemben. Kisemlős közösségek a LAJTA-Project erdősávrendszerében. SE-VI – MME „*Mezőgazdaság és természetvédelem*" Szakmai Konferencia, Mosonmagyaróvár 1999. Május 20-22.

NÉMETH, CS. (2003): Erdbewohnende Kleinsäugetierarten in West-Ungarn. - In: Int. Clusius Forschungs-gesellschaft Güssing, Red. CH. HOLLER (2003): Zum Stand der naturkundlichen Forschung im Südburgenland und im angrenzenden Ungarn.- Burgenländische Forschungen, Burgenländisches Landesarchiv, Eisenstadt.

### 6. 3. Manuscript Essays, Reseach Reports

NÉMETH, CS. (1993): Kisemlős vizsgálatok a LAJTA-Project erdősávrendszerében. - TDK dolgozat, Sopron, EFE Vadgazdálkodási Tanszék

NÉMETH, CS. (1994): Kisemlős vizsgálatok a LAJTA-Project erdősávrendszerében. – Szélkiáltó, Sopron, MME Soproni HCS, 8. szám

NÉMETH, CS. (1995): Kisemlős állományvizsgálatok a LAJTA-Project erdősáv-rendszerében. – Diplomamunka, Sopron, EFE Vadgazdálkodási Tanszék

JÁNOSKA, F. ÉS NÉMETH, CS. (1993): Az erdősávok kisemlős közösségeinek vizsgálata. – In: FARAGÓ, S. (1992): Természetes vadpopulációk fenntartásának lehetőségei agrár környezetben, különös tekintettel a fogoly *(Perdix perdix)* megőrzésére. – LAJTA-Project kutatási jelentés, 331-334.