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HABITAT SELECTION OF THE EURASIAN BADGER IN VARIOUS AREAS OF HUNGARY

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ABSTRACT – Habitat Selection of the Eurasian Badger in Various Areas of Hungary
We examined the habitat use patterns of the Eurasian badger in one area among mountains, one among hills and one on the Great Plain of Hungary. These examinations were based on burrow estimation by striped transect, and they were carried out by categorising the habitat types in which badger burrows were detected.
We found that badgers prefer forested areas, predominantly pine-forests and mixed pine-forests, for digging their burrows. They seem to avoid areas of open fields, although occasionally they do dig burrows in such areas, especially if the percentage of forest cover is low.

Keywords: Eurasian badger, habitat selection, den

INTRODUCTION

The distribution of the Eurasian badger extends from Ireland to Japan, spreads from Finland throughout Israel across Iran and Afghanistan even to China. It is only lacking from the Balearic Island in Europe. The occurrence ranges between 1600 and 1700 above mean sea level. The European badger may find its life conditions in deciduous and mixed forests but shrubby and agricultural areas, as well (MITCHELL-JONES ET AL., 1999). WOZENCRAFt (2005) in his last-edited summary particularly emphasizes the recently experienced significant increase of population size in the British Islands and Ukraine. According to HOLMALA AND KAUHALA (2006) the population of badger is growing in whole Europe. The oral rabies vaccination program might stay in its background.
The European badger in Hungary was protected between 1973 and 2001, since than became game species and hunted from 1st of June till 28th of February. However its population was still continuously growing and spreading. The area-occupation of European badger in Hungary can practically be considered to be finished and nowadays there is not any Hungarian landscape without the occurrence of this species (LANSZKI AND HELTAI 2010). The reason of the wideness of the European and Hungarian dispersal area, and increase in populations in several European countries and so in Hungary is the adaptability and flexibility of this species both to habitat and feeding conditions. During its habitat selection the aspects of equally the suitable sites for digging setts that are not threatened by falling down (NEAL AND CHEESEMAN 1996), and the proper sheltering (CRESSWELL ET AL., 1990) are important for the Eurasian badger. HELTAI AND KOZÁK (2004), and KOZÁK AND HELTAI (2006) studied the species' selection of den sites, principally considering the aspects of vegetation and cover, during their badger-habitat-preference studies on the Hungarian Plain (Erdőspuszta next to Debrecen, and Hortobágy). Their data showed small preference of forested areas within the two sample sites where environmental factors (such as geological, hydrological, feeding source patterns) enable. At Erdőspuszta preference of the Pinus sylvestris plantations is showed. They suggest that the very low preference of

opened areas on the Hortobágy sample site may be caused by geological and hydrological parameters. Based on the data of their samples the habitat-preference of European badger on plain only partly depends on the vegetation and cover. The geological and hydrological parameters, by chance the nutrient-supply situation are often more dominant. Beside this study that was done in Hajdú-Bihar country there are not any other data available from Hungary about the habitat use of this species. Hence our aim was to study the habitat use at the choosing burrows' location in case of the Eurasian badger in three different landscapes: in the Bakony that is considered to be mountainous area in the Hungarian context, in the Gödöllő Hills, and at a recently occupied habitat that is called Kiskunság. We investigated the preferred and avoided habitat type of the three different landscapes and we were searching for the habitat parameters that were decisive to the presence of the species.

MATERIALS AND METHODS

Study areas

Bakony

The Bakony study area was a fenced, 3768.46 ha game preserve that is bordered by eight settlements (Veszprém, Márkó, Bánd, Szentgál, Nemesvámos, Tótvázsony, Nagyvázsony és Úrkút). The terrain within this area is mainly unstructured. The average valley density is between 2.5 – 2.6 km/km^2, the average above mean sea level is 320 metres. The soil consists of low productive leptosols on limestone and dolomite bedrock. Forests of this area are supplemented with diverse size clearings, meadows, agricultural areas, and watercourses. Almost the entire game preserve – from Nagyvázsony to Bánd – is continuously forested. The together 400 ha ploughland is utilized as game field; alfalfa, triticale, wheat, sunchoke (Helianthus tuberosus), and partly grass is produced on this areas.

Gödöllő Hills

The observations were done between Isaszeg and Pécel. The former bedrock of the Gödöllő Hills was loess that was covered by a thinner-thicker diluvial sand sediment layer. Beside the typical loess that covers large areas loessy sand and sandy loess are frequently found, as well. This landscape ranges between 130-344 a.m.s.l. The scale of soil-erosion is remarkable; the typical site condition is dry. Water reservoirs, fishponds can be found both within and out of the forests between Isaszeg and Pécel. The size of the observed area included into the burrow-estimation was 1430 ha.

Kiskunság

We conducted the investigation on the borderline of Pest and Bács-Kiskun countries between Kunpeszér and Kunszentmiklós all together on 4060 ha. This area can be spited into two parts. The first is a solonchack barren, saline meadow and pasture called Nagyrét (protected area) that is located at the lower elevations of the Danube's former floodplain. The groundwater level may be high in the early spring here, but till the beginning of the summer, due to the evaporation and the suction effect of the sewage system, that was implemented in the beginning of the XXth century to solve the groundwater problems, dries up and the saline marshes are only to find separately in small patches.

The soil of the Kiskunság-study area is mainly bad water balanced heavy soil, additionally with a few sandy back. The other part of the investigation area is surrounding the eastern part of the Nagyrét. It consists of mainly non protected agricultural areas that are complemented by small forest patches and settlement mosaics. Here we almost exclusively

find only sandy soils. Between 95 and 102 a.m.s.l. without any steep or unexpected changes, that means evenly plain site.

Burrow estimation

Burrows were estimated by parallel, North-South oriented stripped transects at all the three areas. The decision whether the found den is inhabited or not and whether the inhabiting species is Eurasian badger or red fox, was based on the surrounding indirect indices (footprint, latrine). The widths of the respective track-sections were continuously recorded. During the implementation, data recording, and evaluation of our field work we used the methods given by HELTAI AND KOZÁK (2004), and KOZÁK AND HELTAI (2006).

Calculation of habitat preference

After determining the exact locations of badger-burrows that were found in the three different study landscapes the scales of preferences were counted according to the Ivlev's formula (Ivlev 1961): Px=(A-B)/(A+B) where A is the rate of burrows in the respective habitat type compared to the total number of burrows within the respective landscape; B is the rate of the area of respective habitat type to the total area of the respective landscape; Px is a value of preference/avoidance of the respective habitat type (range [-1;1]). (+1) means total preference whereas (-1) suggests overall avoidance. The significance of the preference values were calculated using Chi^2-test, and Bonferroni Z-test after the necessary merges of the habitat-type categories. The same tests were used to compare the landscapes and to determine the most important habitat categories that are decisive at the habitat use of the European badger.

RESULTS

The results of habitat use based on the spatial distribution of the burrows show overall preference of coniferous forests (Ivlev-index values per landscapes: Gödöllő Hills: 0.62; Bakony: 0.43; Kiskunság: 0.91) and general avoidance of opened sites such as meadows, pastures, ploughlands, however entire avoidance only were found in the Gödöllő Hills (Ivlev-index values per landscapes: Gödöllő Hills: -1.00; Bakony: -0.30; Kiskunság: -0.63) (*figure 1.*).

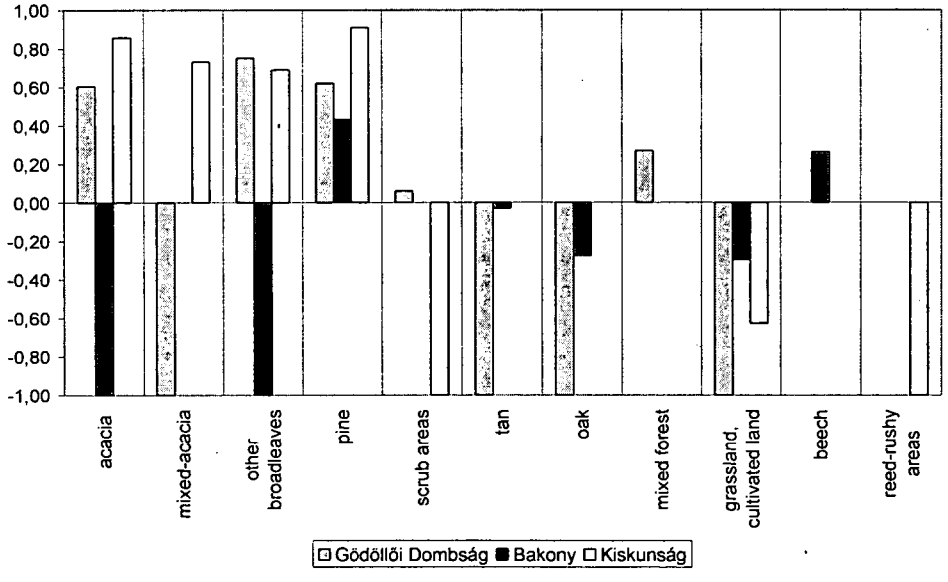

Figure 1. Habitat preference values on the study area, estimated by European badger-burrows (Y-axis: Ivlev-index). Missing values mean absence of the respective habitat type at the certain landscape.

Using Bonferroni Z-test the preference of Robinia pseudoacacia and coniferous forests were proven to be significant in the Gödöllő Hills, just like the avoidance of opened sites (Bonferroni Z (4) = 2.500; $p<0.05$). The other preferences and avoidances were not significant. In the Bakony neither of preference values were significant (Bonferroni Z (3) = 2.407) but in the Kiskunság landscape preference of deciduous forests and avoidance of opened sites were significant (Bonferroni Z (3) = 2.407; $p<0.05$). However it is important to underline, that the above mentioned habitat categories had to be merged into larger groups during the significance-analyses, because otherwise the area of certain habitat types often were not large enough compared to the total area size, which unable us to use the Chi^2-test.

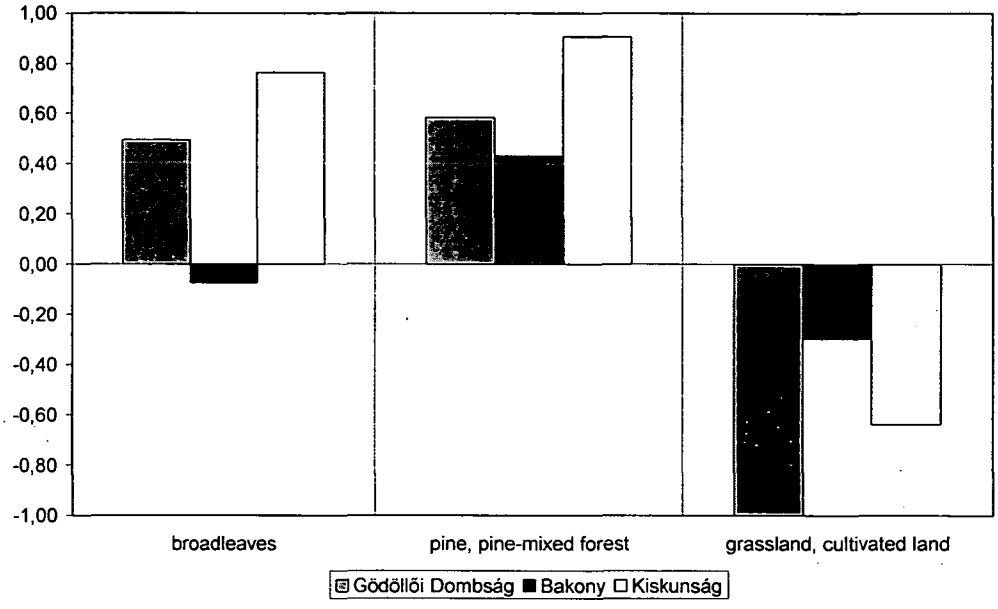

Figure 2. Comparison of the merged habitat uses of the three studied landscapes (Y-axis: Ivlev-index)

To be able to compare the landscapes habitat categories first had to be merged. It had two main reasons: the above mentioned statistical criteria and the fact, that these landscapes are different, and some habitat types are not to find at either landscapes. This comparison confirms the results of the previous observations about the avoidance of opened sites and preference of coniferous forests. All of the preferences and avoidances of the three habitat types in the Gödöllő Hills were significant ($p<0.05$). In the Bakony were neither of the values significant, hence in the Kiskunság preference of deciduous forests and avoidance of opened sites are considered to be significant (Bonferroni Z (3) = 2.407; $p<0.05$) (*figure 2.*).

CONCLUSIONS-DISCUSSION

Our results prove our hypothesis that the European badger can widely adapt to the habitat conditions. However, taking in account the feeding habits and habitat use of this species, mainly based on research studies in the United Kingdom (NEAL AND CHEESEMAN, 1996; LANSZKI AND HELTAI 2010), the stronger preference of coniferous or partly coniferous forests than the preference of deciduous forests is surprising. Its reason is probably the fact

that the coniferous plantations on the Hungarian Plain were mainly implemented on extensive, low productivity sand-soils that are suitable for digging burrows. The avoidance of the opened sites was also an expected result. However, the plasticity of the European badger is shown well by the fact, that in case of necessity it burrows on opened sites as well, especially at low forestation (e.g. Kiskunság).

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