TISCIA 35, 37-40

EDGE EFFECT ON SPIDER ASSEMBLAGES

R. Gallé and B. Fehér

Gallé, R and Fehér, B. (2006): Edge effect on spider assemblages. *– Tiscia 35, 37-40*

Abstract. In the Great Hungarian Plain we collected 3234 adult spiders belonging to 66 species in a poplar forest, its clearing and the nearby grassland. *Titanoeca psammophila* Wunderlich, 1993 occurred in the samples which is new for the Hungarian fauna.
Correspondence analysis showed similarity between the spider assemblages of the wind grooves and those of the clearing.
We applied also correspondence analysis on the data of pitfall traps arranged in transects to locate the edge zone. Higher plant and spider diversity were found in edge zone. Mantel test showed significant correlation between changes of the vegetation and the spider assemblages.

Keywords: diversity, vegetation pattern, Araneae, community, sandy habitat

R. Gallé, B. Fehér, Department of Ecology, University of Szeged, H-6701 Szeged, PO Box 51, Hungary

Introduction

The landscape transformation brought about by the human activity has resulted in the fragmentation and loss of natural habitats. This trend is especially strong in the Great Hungarian Plain, leading to a patter of small quasi natural patches embedded into a matrix of agricultural fields.

As the edges have great influence on such small and fragmented patches, the transition zones are in the focus of both conservational and ecological researches (Horváth *et al*. 2002). The ecotone is a zone where spatial change of the community variables is more pronounced than on the sides of the zone (Lloyd 2000). Ecotones and edge zones are used as synonyms in present paper. Edges may affect the organisms by causing changes in abiotic conditions (Murcia 1995). Thus the abundance, distribution and life cycles (Maeflait 1990) of populations change together with the interactions between them (Murcia 1995). The biota itself plays a role of creating and maintaining the spatial heterogeneity of abiotic factors. For example plants affect air and soil humidity, temperature, intercept light and rainfall (Stewart *et al*. 1999). Vegetation diversity is claimed to be higher in edge zones because of the propagule rain from both adjacent communities (Zólyomi 1987), and the vegetation with high structural and floral diversity tends to have higher invertebrate diversity (Meek *et al*. 2002, Bedford and Usher 1994, Baines *et al*. 1998). Besides higher diversity (Odum 1983), the number of species may also reach higher value by the contribution of species of the adjacent communities and in some cases edge associated species (Magura and Tóthmérész 1997, 2000). Ecotones may serve as unique habitats for these species (Fuisz and Moskát 1992), therefore the protection of edge zones may play an important role in preserving biodiversity (Magura and Tóthmérész 1998).

Arthropods account for the highest proportion of animal biodiversity, and spiders as abundant polyfagous predators are likely to have a great influence on other invertebrate communities (Martin and Major 2001).

In this paper we analysed the properties of spider assemblages of a poplar forest clearing, the forest and the neighbouring sandy grassland in order to answer the following questions:

(1) Do the spider assemblages of the forest and the clearing differ?
(2) Is there any similarity between the assemblages of the clearing and the nearby grassland?
(3) How wide is the transition zone between the clearing and the forest in case of vegetation and spider assemblage?
(4) How does the vegetation influence the spider assemblages?

(5) How does the diversity change along the transects from the forest interior to the clearing?
(6) Are there any ecotonal specialist species?

Materials and methods

Study area and sampling

Our study was carried out in the Kiskunság National Park, near Bugac village in South Hungary. Both vegetation and spider fauna of the study area are relatively well known (Körmöczi 1989, 1991, Loksa 1987, Kerekes 1988).

In order to compare the spider assemblages of the clearing and the grassland, we placed 12-12 pitfall traps in the following habitat types: Sand dune top (ST; *Festucetum vaginatae*), wind groove 1. (WG1; *Molinio-Salicetum rosmarinifoliae*), wind groove 2. (WG2; *Molinio-Salicetum rosmarinifoliae* without considerable abundance of *Salix rosmarinifolia*), forest interior (FI;), clearing (C;). The pitfall traps were plastic jars (6 cm in diameter) filled with ethylene-glycol as preservative.

Ten parallel transects of pitfall traps running from the forest clearing through the edge zone towards the forest interior was applied to examine the effect of forest edges on spider assemblages the distance between the traps was at least 4 meters. The relative cover values of plant species were recorded from 1×1 meter quadrates which were placed in three transects. Each transect consisted of 30 quadrates. The exact arrangement of the pitfall traps is shown in Fig. 1.

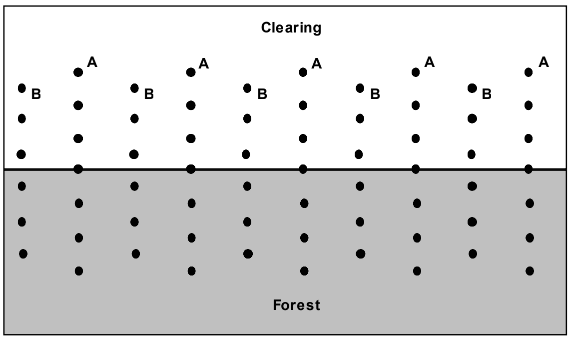

Fig 1. The arrangement of pitfall traps. The data of traps marked with the same letter were pooled.

Data analysis

Principal Component Analysis (PCA; Pilou 1984) was applied in order to determine whether there is difference between the spider assemblages of the forest and the clearing, and to reveal the resemblance of the clearing and the nearby grassland.

We pooled the data of pitfall traps working at the same distance from the trunks of the last trees to 13 groups. Scores from axis 1 of CA ordination were used to define the position and width of the ecotone. Upper and lower quartiles between the ordination score of the pooled data of pitfall traps placed in the forest interior and in the clearing were calculated. Starting from the forest interior consecutive group of traps were added to this zone until traps with ordination score beyond the corresponding quartile occurred. The same was done starting from the clearing. This method gave three zones: forest, clearing and edge zone (Lloyd *et al.* 2000). We used also the same analysis in the case of the vegetation data.

Mantel test on the basis of Bray-Curtis similarity was used to show how the vegetation influences the spider assemblages.

In order to reveal how the diversity changes along the transects Shannon and Simpson-Yule diversity were calculated for each group of traps. Kruskall-Wallis test was applied to show the difference between the forest, the clearing and the edge.

Results

A total of 3234 adult individuals belonging to 66 species were collected including *Titanoeca psammophila* Wunderlich, 1993 which is new for the Hungarian fauna.

Correspondence analysis showed similarity between the spider assemblages of the wind grooves and the clearing. The spider fauna of the clearing differs considerably from the forest (Fig. 2.).

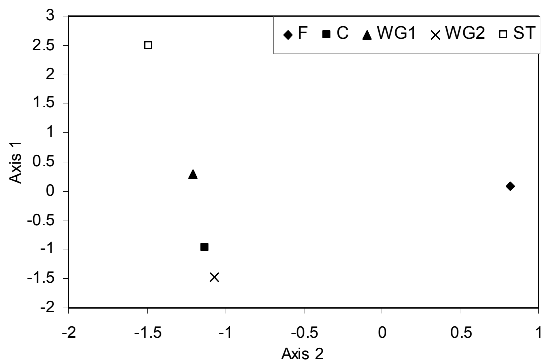

Fig 2. Correspondence analysis of the spider assemblages of the study area. F – forest, C – clearing, WG1 – wind groove (*Molinio-Salicetum rosmarinifoliae*), WG2 – wind groove (*Molinio-Salicetum rosmarinifoliae* without considerable abundance of *Salix rosmarinifolia*), ST – sand dune top (*Festucetum vaginatae*).

The position of the edge zone in the case of the vegetation and the spider assemblages overlapped (Fig. 3.). This transition zone is about 8 meters wide. The Mantel test showed close correlation between the vegetation and the spider assemblages (Mantel test r=0.633, N=13, p<0.001).

In case if spider assemblages we found no significant differences in species richness of the clearing, the edge and the forest interior (H_2=5.763, NS). Both Shannon and Simpson diversity show a significant maximum at the edge zone (Fig. 4A., Kruskal-Wallis test for Shannon diversity H_2=11.49, p<0.005; for Simpson diversity H_2=64.52, p<0.005). We found that the diversity of the vegetation is fluctuating at the edge, no significant differences were detected (Fig. 4B., Kruskal-Wallis test for Shannon diversity Ks=6.39, NS; for Simpson diversity K_s=3.37, NS).

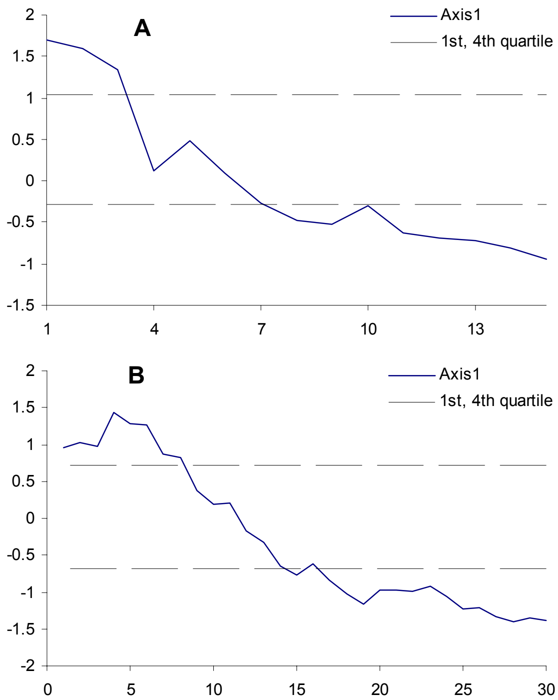

Fig 3. **A** The first axis of Correspondence analysis of the traps of transects starting from the clearing and running towards the forest interior are plotted against the distance from the first trap (clearing). **B** The results of the Correspondence analysis of the relative cover values of botanical quadrates plotted against the distance from the quadrat (clearing).

Discussion

According to Odum (1983) there might be some populations which occur only in the edge zone or reaches the highest density there (Lloyd et al. 2000), because they can utilise sources of both neighbouring habitats (Jose et al. 1996). These categories were made for plant populations, which detect the habitat heteromorphy much sharper then the spiders (Kerekes 1984). In the case of present study the edge zone was so narrow (6-8 meters), that the ground dwelling lycosid spiders move such distances in one day (Greenstone 1979, Kiss and Samu 2000). The net builder spiders have smaller home range, and are strongly influenced by edges, because these populations are highly correlated with the physiognomy of the vegetation. The plant species composition together with the web building spiders of forest edges are influenced by several microclimatic factors such as wind (Baldissera *et al.* 2004), while the forest interior offers different kinds of structures for web attachment (Robinson 1981). However Horváth *et al.* (2002) found higher web spider richness in the edge zone. In the present study we found no significant differences between the species richness of the forest the edge and the clearing.

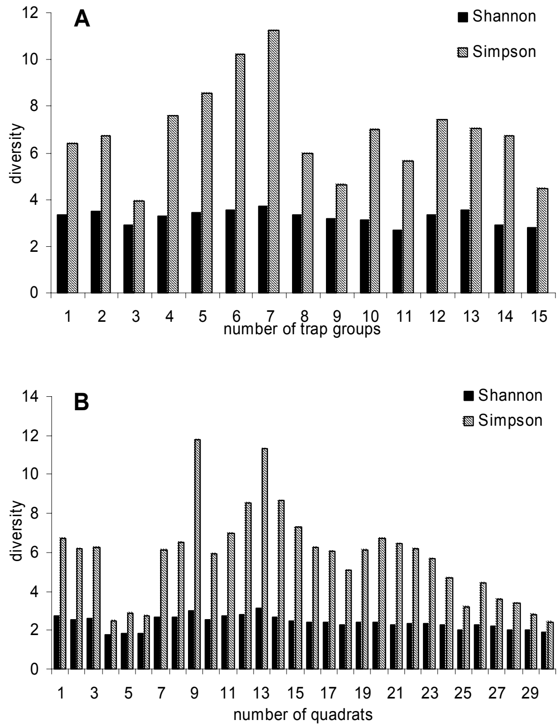

Fig 4. **A** The diversity pattern of the spider assemblages along the transects, starting from the clearing. The plot shows a significant peek at the transition zone. **B** The diversity of vegetation along the transects, also starting from the clearing.

There are several former studies showing the diversity of the ecotone higher than the adjacent habitats (e.g. in case of carabids: Magura and Tóthmérész 1997, 1998, Magura *et al*. 2001, vegetation: Zólyomi 1987, spiders: Tóth and Kiss 1999, Horváth *et al*. 2002). Others found that the value of the diversity is between the diversities of the two neighbouring habitats (Jose 1996, Lloyd *et al*. 2000). Thus the diversity pattern of the present study is not general.

References

Baines, M. Hambler, C., Johnson, P. J., Macdonald, D. W. and Smith, H. (1998): The effect of arable field margin management on the abundance and species richness of Araneae (spiders). — Ecography 21, 74-86.

Baldissera, R., Ganade, G. and Fontoura, S.B. (2004): Web spider community response along an edge between pasture and *Araucaria* forest. — Biological Conservation 118, 403-409

Bedford, S. E. and Usher, M. B. (1994): Distribution of arthropod species across the margins of farm woodlands. — Agriculture, Ecosystem and Environment 48, 295-305.

Fuisz, T. and Moskát, Cs. (1992): The importance of scale in studying beetle communities: Hierarchical sampling or sampling the hierarchy? — Acta Zoologica Academiae Scientiarum Hungaricae 38, 183-197.

Greenstone, M.H. (1979): A line transect density index for wolfspiders (*Pardosa* spp.), and a note on the applicability of catch per unit effort method to entomological studies. — Ecological Entomology 4, 23-29

Horváth, R., Magura T. and Tóthmérész B. (2002): Edge effect on weevils and spiders. — Web Ecology 3, 43-47.

Jose, S., Gillespie, A. R., George, S. J. and Kumar, B. M. (1996): Vegetation responses along edge-to-interior gradient in high altitude tropical forest in peninsular India. — For. Ecol. Manage. 87, 51-62.

Kerekes, J. (1988): Faunistic studies on epigeic spider community on sandy grassland (KNP). — Acta Biologica Szegediensis 34, 113-117.

Kiss, B. and Samu, F. (2000): Evaluation of population densities of common wolf spider *Pardosa agrestis* (Araneae: Lycosidae) in Hungarian alfalfa fields using mark recapture. — Eur. J. Entomol. 97, 191-195.

Körmöczi, L. (1989): Short term structural changes in sandy grassland communities. — Acta Botanica Hungarica 35, 145-160.

Körmöczi, L. (1991): Drought-induced changes in a sandy grassland complex in the Great Hungarian Plain. — Acta Biologica Szegediensis 37, 63-74.

Lloyd, K.M., McQueen, A.A.M., Lee. B.J., Wilson, R.C.B., Walker, S. and Wilson, J.B. (2000): Evidence on ecotone concepts from switch, environmental and anthropogenic ecotones. — Journal of Vegetation Science 11, 903-910.

Loksa, I. (1987): The spider fauna of the Kiskunság National Park. — In: Mahunka, S. (ed.) The Fauna of the Kiskunság National Park 2. 335-342. Akadémiai Kiadó, Budapest.

Maelfait, J. P. and De Keer, R. (1990): The border zone of an intensively grazed pasture as a corridor for spiders araneae. — Biological Conservation, 54, 223-238.

Magura, T. and Tóthmérész, B. (1997): Testing edge effect on carabid assemblages in an oak-hornbeam forest. — Acta Zoologica Academiae Scientiarum Hungaricae 43, 303-312.

Magura, T. and Tóthmérész, B. (1998): Edge Effect on Carabids in an Oak-Hornbean Forest at the Aggtelek National Park (Hungary). — Acta Phytopathologia et Entomologica Hungarica 33, 379-387.

Magura, T. and Tóthmérész, B. (2000): Spatial distribution of carabids along a grass-forest transect. — Acta Zoologica Academiae Scientiarum Hungaricae 46, 1-17.

Magura, T., Tóthmérész, B. and Molnár, T. (2001): Forest edge and diversity: carabids along forest-grassland transects. — Biodiversity and Conservation 10, 287-300.

Martin, T. J. and Major, A. (2001): Changes in wolf spider (Araneae) assemblages across woodland-pasture boundaries in central wheat-belt of New South Wales, Australia. — Austral Ecology 26, 264-274.

Meek, B., Loxton, D., Sparks, T., Pywell, R., Picket, H., Nowakowski, M. (2002): The effect of arable field margin composition on invertebrate biodiversity. — Biological Conservation 106, 259-271.

Murcia, C. (1995): Edge effect in fragmented forests: implications for conservation. — Trends in Ecology and Evolution. 10, 58-62.

Odum, E.P. (1983): Basic Ecology. — Saunders Collage Publishing, Philadelphia.

Pilou, E.C. (1984): The Interpretation of Ecological Data. — John Wiley and Sons Inc., USA.

Robinson J.V. (1981): The effect of architectural variation in habitat a spider community: an experimental field study. — Ecology 61, 73-80

Stewart A.J.A., John, E.A. and Hutchings, M.J (1999): The world is heterogeneous: ecological consequences of living in patchy environment. — In: Stewart A.J.A., John, E.A., Hutchings, M.J (eds)The Ecological Consequences of Environmental Heterogeny, 1-9. Blackwell Sicense LTD.

Tóth, F. and Kiss, J. (1999): Comparative analyses of epigeic spider assemblages in Northen Hungarian winter wheat fields and their adjacent margins. — J. Arachnol. 27, 241-248.

Zólyomi, B. (1987): Coenotone, ecotone and their role of preserving relic species. — Acta Bot. Hung. 33, 3-18.