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SHORT TERM STRUCTURAL CHANGES OF AUCHENORRHYNCHA COMMUNITIES ON SANDY GRASSLAND

GY. GYÖRFFY[1] - L. KÖRMÖCZI[2]

ABSTRACT

Movings of dots representing samples of 14 different places of a sandy mosaic-like grassland were investigated in the PCA hyperspace between 1979 and 1986. The extent of structural changes in the Auchenorrhyncha community, that is the instability of the community increased with the steepness of the habitat (r=0.552). The structural stability of the insect community increased in correlation to plant cover (r=0.652). The more diverse the insect community was, the more sensitive it was to the environmental changes. It's main reason was the higher number of species (r=0.63) and not the evenness.

KEY WORDS

Diversity, multivariate analysis, stability.

INTRODUCTION

The matter, which factors cause structural changes in a plant or animal community, depends not only on the type of the ecological community in question, but also on the properties of the habitat. In a sandy grassland for example "a drought lasting for 2 years in a community characterized by many annuals and biennials can produce consideerable change in the com-

[1]Department of Zoology, A.J. University Szeged, Hungary
[2]Department of Botany, A.J. University Szeged, Hungary

munity and must qualify as a disturbance" (Loucks et al., 1985). Most of the studies until now have dealt with the correspondence between the diversity and environmental parameters (plant cover, number of species, plant diversity, vertical stratification, abiotic diversity, and so on; Southwood et al., 1979; Kirchner, 1977; Nagel, 1979; Lawton, 1978; and many others). Dependence of speed of structural changes on environmental or community parameters is less known. In this paper we try to describe such correspondences in Cicadinea communities using ordination methods.

MATERIALS AND METHODS

The sample area is situated in Bugac region of Kiskunság National Park (Hungary). It is a 2 ha part of a previous sandy pasture and it has been fenced since 1976 to prevent grazing. The area is heteromorfous, slashed by grooves and sand hills. Because of 2 m's average elevation difference the investigations vere devided according to the relief. The vegetation consists of 3 main plant community types: Festucetum vaginatae (FV), Potentillo-Festucetum pseudovinae (PFP) and Molinio-Salicetum rosmarinifoliae (MSR). Samples were taken from the typical patches of these associations.

Methods

Our purpose was to examine such parameters, that necessitated the use of permanent sample sites. Samples were taken by Barber traps arranged in 14 groups in different places of the experimental area (fig. 1), each group containing 5 traps in tetragonal arrangement. Insects were collected fortnightly from April till November between 1979 and 1986.

Selectivity of the Barber trap - i.e. it samples insects moving on the soil surface - is advantageous for the present aim, since it excludes the populations connected with higher strata, because their vagility is higher and therefore they are less sensitive to the heteromorfy of the area. When evaluating the results it can be taken into consideration that this type of trap measures also activity or rather density of acti-

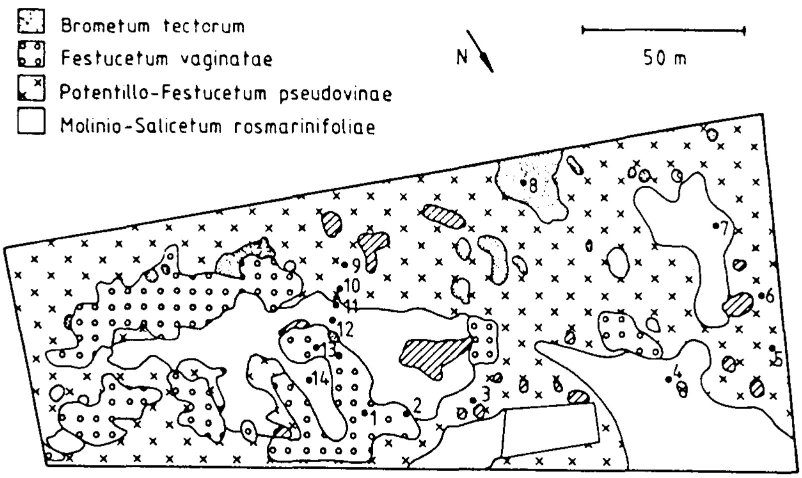

Fig. 1 - Vegetation map of sample area with sites of Barber traps (1-14).

vity (Heydemann, 1956).

At sampling sites we measured the elevation (cm) related to the lowest point of the area. The slope of soil surface (^{o}) was established regarding 2 m's round the traps. Soil water content (%) near the traps was also measured. Vegetation samples were taken around the traps in 4 m^2 quadrats in 1981, 1985 and 1986. Species composition, percentage cover and total plant cover were recorded. We established also the radius (cm) of homogeneous plant association around the traps.

The extent of structural changes of communities was estimated by principal component analysis (PCA) using correlation matrices of annually summed data.

RESULTS

Activity and individual density

To find the connection between data originated from Barber traps and real values of individual density we compared the data of suction traps and the totalized data of Barber traps corresponding to the two reliefs in the same period (1979-1983). This was made in case both of larvae and of imagos, as the imago/larva ratios are very different in the particular traps.

On the basis of the average of suction trap samples of 1979-1983 years the larval number was 2.8 times and the imago number 2.5 times greater in lower relief than that on sand hills. According to Barber traps, however, in grooves the density of activity of larvae is about the half of that on sand hills in the same period, while the density of activity of imagos is the same on both relief. Actually, however, - knowing the real density - larval activity is about 5.4 times, that of imagos 2.4 times greater on sand hills. This increased motion activity was probably caused by the unfavourable microclimate (Andrzejewska and Gyllenberg, 1980). To verify this, we computed correlations between larval number, imago number and imago/larva ratio as degree of fitness of habitat as well as some environmental parameters on the basis of data of Barber traps in the 1979-1986 period.

Table 1 - Correlations of community and environmental parameters.

	1	2	3	4
N (imago) (activity)	0.024	-0.633^{xx}	-0.532^{x}	-0.434
N (larva) (activity)	0.538^{x}	-0.688^{xxx}	-0.675^{xxx}	-0.361
imago/larva (habitat fitness)	-0.863^{xxx}	0.376	0.497^{x}	0.085

significance level: x 0.05
xx 0.01
xxx 0.005

1: elevation; 2: plant cover; 3: plant diversity; 4: diameter of homogeneous patch.

According to the real density-activity relationship the correlation coefficients of the table 1. would be greater values in reality, if we could correct them with individual density. Reactions of larvae are more sensitive to all parameters.

Imagos are less sensitive to elevation, their activity is affected mainly by plant cover. We didn't find significant correlation with patch size of homogeneous plant community, cause of which may be the 2 m's of least patch diameter. It is larger than the average home range, that is most of the material of traps came from smaller area.

Extent of structural change of <u>Cicadinea</u> communities

The extent of structural changes was established by comparing the positions of <u>Cicadinea</u> communities of the sampling sites in PCA hyperspace in different years. Shifts of objects during years were computed as Euclidean distances on 5 principal component vectors weighted by percent variance of vectors. These values were regarded as rate of change and of instability, respectively. The correlations between these distance values and different environmental and community parameters were calculated, too (table 2).

Table 2 - Correlations between the rate of instability of Cicadinea community (Euclidean distances in PCA space between 1979-1986) and different parameters.

	instability	significance level
elevation	0.009	n.s.
slope	0.552	0.025
plant cover	-0.652	0.01
plant diversity	-0.299	n.s.
Cicad. diversity	0.247	n.s.
Cicad. spec. number	0.630	0.01
imago ind. number	0.338	n.s.
soil water content	-0.580	0.01

Knowing the results that originated from suction trap samples (Györffy and Körmöczi, in this volume) positive correlation would have been expected between elevation and instability. Possible cause of failure of this is, that the sucked samples originate from the two extremes of relief, while in the environment of Barber traps being in different elevation the plant covers or diversities are often very similar, and the effect of these is more essential than that of the elevation. It was verified by strong correlation with plant cover. Increase of plant cover (and of diversity) decelerates structural changes of animal community, since it reduces the unfavourable effect of stress conditions.

Slope of habitat reduces the stability of community. On one hand it may be in connection with soil water content, that decreases with increasing slope (r=-0.53), and the water content influences the condition of host plant and the availability of the plant sap. On the other hand its cause may be the drift of imagos, accidentally also by rainwater, or the higher number of transit species arising from transitional character of such biotops.

Its correlation is not significant with the diversity of Cicadinea community, but with species number it is. It is interesting, because we found a very strong correlation between diversity and species number (r=0.823 p 0.005). Similar to results of Witkowski (1978) on weevil community, we found strong correlation between instability and species number.

DISCUSSION

Müller's (1980) statement, that "a spatial dispersion of leafhopper communities is determined by the animals' demands on microclimate", is prevalent to a greater extent in such habitats of extreme environment, as that examined by us (Györffy and Pollák, 1983). In the previous paper (Györffy and Körmöczi, in this volume) it has been a reference to the fact, that the extent of structural change of a community is partly the function of microclimate, because the changes are less in the subsequent years in patches of favourable environmental effect.

Our present results reinforce also this opinion, since we found the strongest correlations with the factors, that moderate the climatic extremities. That's why the plant cover or the slope of habitat are more important, than plant diversity or the elevation.

In such cases we can talk about abiotically stressed community, when the importance of community parameters (e.g. insect diversity) is only secondary as against that of factors determining the microclimate, at determination of the speed of short term structural changes.

REFERENCES

Andrzejewska, L.; Gyllenberg, G. (1980) Small herbivore subsystem. In: Grasslands, systems analysis and man.Eds. A.I. Breymeyer and G.M VanDyne, IBP 19. Cambridge Univ. Press, 201-267.

Györffy, Gy.; Pollák, T. (1983) Habitat specialization of leafhopper community living in a sandy soil grassland. Acta Biol.Szeged.29,153-158.

Heydemann, B. (1956) Die Biotopstruktur als Raumwiederstand und Raumfülle für die Tierwelt. Verh.Deutsch.Zool.Ges. Hamburg,322-347.

Kirchner, T.B. (1977) The effects of resource enrichment on the diversity of plants and arthropods in a shortgrass prairie. Ecology 58,1334-1344.

Lawton, J.H. (1978) Host-plant influences on insect diversity: the effects of space and time. In: Diversity of Insect Faunas. Eds. L.A. Mound and N. Waloff, Blackwell Sci. Publ., Oxford, 105-125.

Loucks, O.L.; Plumb-Mentjes, M.L.; Rogers, D. (1985) Gap processes and large-scale disturbances in sand prairies. In. The ecology of natural disturbance and patch dynamics. Eds. S.T.A Pickett and P.S. White, Acad.Press, Harcourt,71-83.

Müller, H.J. (1980) Die Bedeutung abiotischer Faktoren für die Einnischung der Organismen in Raum und Zeit. Autökologie als Auftrag der Ökosystem-forschung. Biol. Rdchs.18,373-388.

Nagel, H.G. (1979) Analysis of Invertebrate Diversity in a mixed Prairie Ecosystem. J.Kans.Ent.Soc.52,777-786.

Southwood, T.R.E.; Brown, V.K.; Reader, P.M. (1979) The re-

lationships of plant and insect diversities in succession. Biol.J.Linnean Soc.12,327-348.
Witkowski, Z. (1978) Correlations of stability and diversity in weevil communities. Oecologia(Berl.),37,85-92.