Proc. 6th Auchen. Meeting, Turin, Italy, 7-11 Sept. 1987, 147-154.

SECONDARY SUCCESSION OF AUCHENORRHYNCHA COMMUNITIES

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ABSTRACT

The structure of Cicadinea communities living in two reliefs of a sandy grassland was affected by ceasing of grazing and climatic alterations of 10 years. The changes in structure of communities are fast on sand hills, but no definite trend of succession could be observed. The community of grooves is more stable in a short period, but considering long term changes the successive character becomes dominant. From the 6th year the strong macroclimatic alteration reversed the successional process. In patchy environment more extreme patches can be referred to as having a more resilient community, while in suitable sites relatively resistent community can be found.

KEY WORDS

Community structure, resilience, resistance.

INTRODUCTION

Beside sporadic studies of primary succession (e.g. Gibson et al., 1987) ecologists examining herbivorous insects more often deal with different kinds of secondary succession (Purvis and Curry, 1980; Brown, 1982). These are mostly changes after perturbation (Horn and Dowell, 1974; Morris, 1973),

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or regeneration processes following them (Morris, 1967; Southwood et al., 1979). Most of these works include only short (2-3, rarely 6 years) period, which is enough to the first steps of succession. To study the properties of a community succession, the appropriate choice of time scale is very important (Whittaker, 1974).

In this paper secondary cuccession of a Cicadinea community is described in a sandy grassland after ceasing of grazing, during a 10-year period. We search for connection with similar changes of vegetation and with macroclimate.

MATERIALS AND METHODS

The investigations were carried out in the Bugac region of Kiskunság National Park (Hungary). A 2 ha part of the sandy grassland having been grazed by cattle and sheep for a long time was fenced in 1976. (For further details see Györffy and Körmöczi, in this volume.)

Climate of the region is warm with few precipitation in many years average. From May till September it is semiarid. The amount of precipitation sometimes exceeded the average in the first 5 years, while from 1982 it decreased drastically. The arid periods became longer and longer from this year.

Sampling methods

Vegetation samples were taken from each plant community in 4 m^2 permanent quadrats in 1981,1985 and 1986. Species composition, total plant cover and % cover of species were recorded.

Insects were sampled by suction traps fortnightly from April till November between 1977 and 1983, and in 1986. We collected the material of 5 quadrats of 1/4 m^2 in both reliefs. From 1981 we doubled the number of samples on sand hills because of the differences between vegetation types, Festucetum vaginatae and Potentillo-Festucetum pseudovinae.

Methods of elaboration

From the rough density data we calculated "individual days" (Petrusewicz and Macfadyen, 1970) for each collecting period. In this way we could compare different years with the same reference. The community diversity was calculated by using Shannon-function. For measuring similarities of fauna between reliefs or periods we used Czekanowski and Renkonen indices. The ordination of data was carried out by principal component analysis (PCA) using the correlation matrices of basic data. The length of shift of objects in PCA hyperspace was measured by computing weighted Euclidean distance of 5 PCA vectors.

RESULTS

The resemblance of Cicadinea communities of two reliefs is very low in the examined period (fig. 1a). On sand hills the successional trend bifurcated, and this accounted for the extension of samplings to two plant communities on this relief.

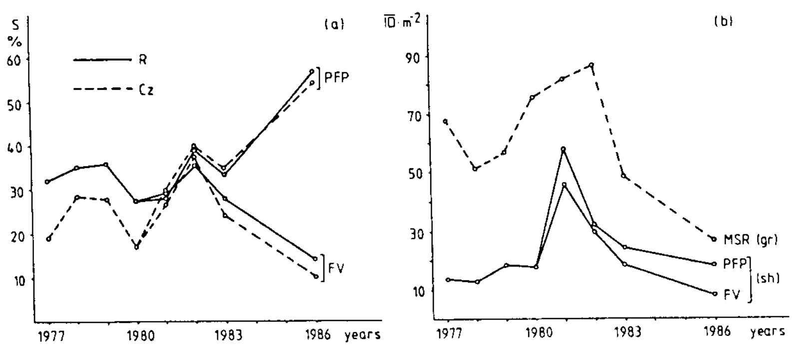

Fig. 1 - Similarities of Cicadinea communities between the two reliefs (a) R: Renkonen, Cz: Czekanowski, and the change of individual day in the examined period (b). MSR: Molinio-Salicetum rosmarinifoliae; PFP: Potentillo-Festucetum pseudovinae; FV: Festucetum vaginatae; gr: groove; sh: sand hill.

In the beginning of the period the density increased more in grooves and less on sand hills, than later (fig. 1b). The density increasing more in grooves aftre the macroclimatic change in 1982 may be caused by immigration of populations from higher relief. The less sharp change of PFP verifies the importance of microclimate.

In the ungrazed area the number of Cicadinea is higher, than that in grazed grassland, Cicadinea community of which consists of 22 species (fig. 2a). It was probable after structural change of vegetation, as follows:

	species number			diversity			plant cover		
	1981	1985	1986	1981	1985	1986	1981	1985	1986
MSR	8	9	17	2.29	2.63	3.41	100	95	90
PFP	7	13	18	1.93	2.83	3.53	80	75	75
FV	7	13	14	1.86	2.72	2.99	60	60	55

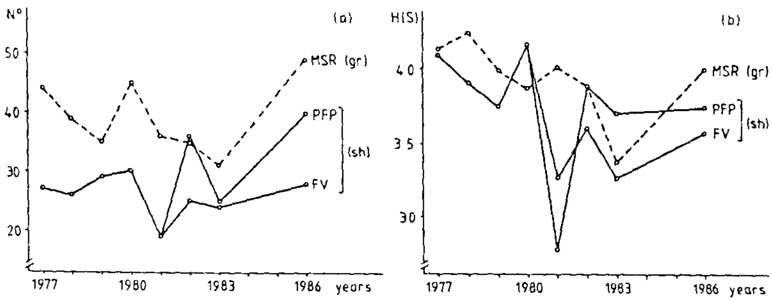

Fig. 2 - Dynamics of species number of Cicadinea (a) and of diversity (b). For labellings see fig. 1.

The fluctuation of species number on sand hills affected more the change of diversity, while in grooves the component of evenness is dominant. Diversity is formed considerably by macroclimate, its effect is modified at the level of microclimate. The multivariate correlation coefficients between climatic factors and diversity of different communities are: FV: 0.74; PFP: 0.35; MSR: 0.59.

Persistence of the community was estimated by resemblance of dominance of species between years (fig. 3a). The low average similarity of the community of sand hills is connected with larger fluctuation. The community of grooves is more resistent, its changes are more moderate. On the basis of similarities related to the first year (fig. 3b) the segregation is less on sand hills in spite of larger fluctuation,

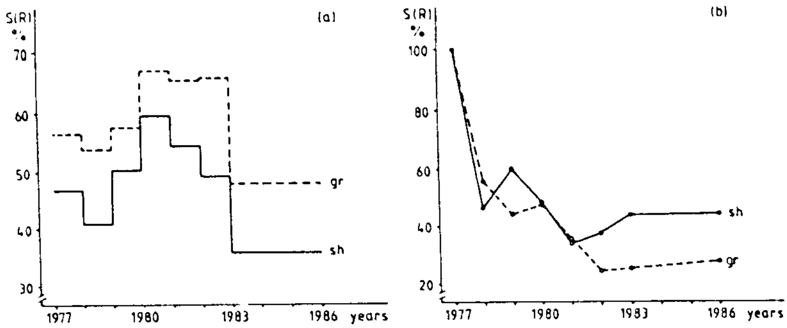

Fig. 3 - Similarities of Cicadinea communities between subsequent years (a) and of Years related to the first year (b). gr: groove; sh: sand hill.

and the resilience of community is greater. In grooves the degree of resistance is higher, but the segregation is larger.

Examining the positions of sample sites on the basis of their Cicadinea community in PCA space (fig. 4a) the points of the two reliefs are separated sharply along the first axis.

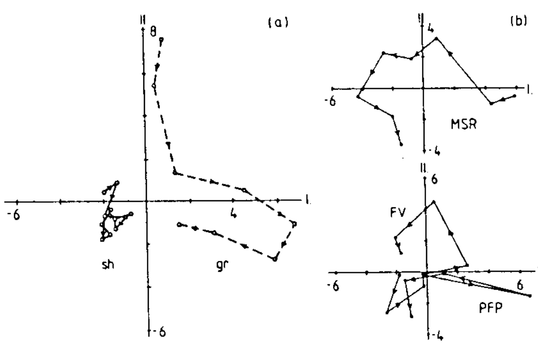

Fig. 4 - PCA scatter diagrams of all samples (a) and of the two reliefs separated (b). (1. and 2. axis; the points of subsequent years are connected with arrows.) For labellings see fig. 1.

This is caused by the set of species, that occure mainly in grooves (93 %; Györffy and Pollák, 1983). Also the 2nd axis is determined by the species of lower relief, though their average occurence is lower there (74 %). These are eurytop species. The important species, however, at the 3rd axis are xerotherms, their occurence in grooves is only 25 %.

The separated analyses of two reliefs (fig. 4b) show the stop of successional process and its turn traceable to climatic causes along the first axis. Changes of community of grooves are more directional, that of sand hills are more vigorous, but less directional.

Fig. 5 shows the Euclidean distances of PCA vectors related to the first year. Alteration of Cicadinea community is greater, more directional and more even in grooves, in connection with changes of MSR. Vegetation and insects of higher relief changed less according to the more extreme circumstances.

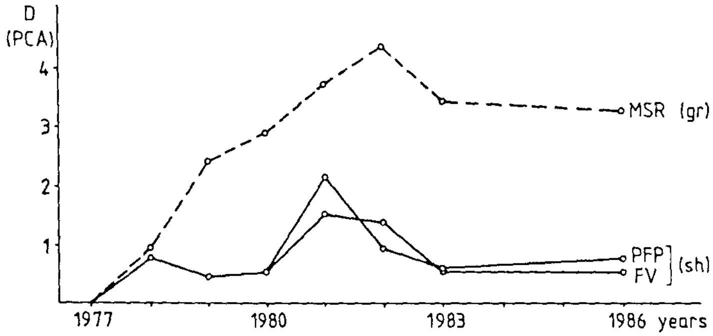

Fig. 5 - PCA distances between the first and successive years. For labellings see fig 1.

DISCUSSION

Secondary successional processes caused by ceasing of grazing were different on different microclimatic places of patchy environment. Individual density increased according to expectations (Morris and Plant, 1983). Becoming dry the climate turned this trend similar to short term observations of Morris and Plant (1983). The increase of species richness and diversity is caused mainly by advantageous changes of vegetation (Stinson and Brown, 1983; Morris and Plant, 1983; Brown and Southwood, 1983). Alteration of diversity shows the strong effect of climate, instead of successional trend.

The extent of change of community structure is the function of microclimate of habitat patches. Water supply, that is a key factor, is more favourable in grooves (Körmöczi et al., 1981), that's why community of that is able to tolerate dry period for a short time. Cicadinea communities approached grazed condition because of drying, that was observed also by Horn and Dowell (1974) on different insect families in a half year examination. In favourable patches resistance of communities is higher, successional changes happen with smaller steps, but more directional, than in more extreme sites. Communities of later are less resistent, but very resilient and strongly fluctuating because of environmental changes. It is very identical with results of Watt (1968, c.f. Holling, 1973) on insects of canadian forests. At this example Holling (1973) mentions the resilience as an alternative of stability. According to our results, however, highly resilient community of extreme habitats altered less during the examined period. In spite of fluctuations strongly resilient community may be more stable in a long term, while resistent one in short periods shows more definite successional trend in long term, in this way it is less stable.

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