COMPARISON OF BIOINDICATIVE VALUE OF VASCULAR PLANTS AND SPIDERS IN CLASSIFICATION OF ECOSYSTEMS

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Abstract
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Gradient analysis, based on parallel inventories of spiders and vascular plants in 24 sites around Čubernice Nature Reserve, central Moravia, has been used for a simple classification of ecosystems. Moisture and man-induced disturbance of the habitat are the main factors affecting the differentiation of both the plant and spider communities. The correlation coefficients r_S if calculated on the basis of spiders and flora, expressing the moisture and man-induced disturbance of the habitats, are highly significant, the former being 0.875, and the latter equalling 0.689.

Introduction

Bioindication became an important tool in ecology. Knowledge of specific relationships between particular organisms and environmental factors enables a quick and fairly reliable evaluation of the essential features of a given biotope. Therefore, there is an increasing interest in the utilization of indicative value of various biota in numerous fields of human activities. However, utilization of various life forms for bioindication is limited by the poor ecological knowledge of individual species. This is why only a few of the better known taxonomic groups are used for this purpose.

The present paper analyses observations performed in the Čubernice Nature Reserve near Plumlov, central Moravia, and its nearest surroundings in 1982 and 1983. The objective of this work is to combine the data on physical environment and vegetation summarized in an earlier work (Klimeš, 1983) and the data on spiders published by Špičáková (1985), and to examine their value in the bioindication of different habitats.

Description of the sample area

The Čubernice N.R. is a significant locality of xerothermic flora and fauna in central Moravia. A varied mosaic of grass, shrub and tree communities is locally heavily influenced by grass cutting and fertilization. Our study refers to a catena (Opp, 1984) on a slope facing SSW inclined between 10 to 30 degrees, with locally appearing outcrops of culm slates (Fig. 1). A 176 m long top-to-foot transect crossing 38 m difference of elevation comprised a fairly steep and wide gradient of moisture and a varied scale of man — induced disturbance.

Mesoclimatic factors are characterized by the following data from the Prostějov meteorological station: 8.5 °C average annual temperature; 14.9 °C average temperature during the growing season, 577 mm annual total of precipitation, 369 mm rainfall during the growing season, 210 to 220 days per year with the average temperature above 5 °C, 150 to 160 days with that above 10 °C, and 80 to 100 days per year with the average temperature above 15 °C (Vesecký, 1960).

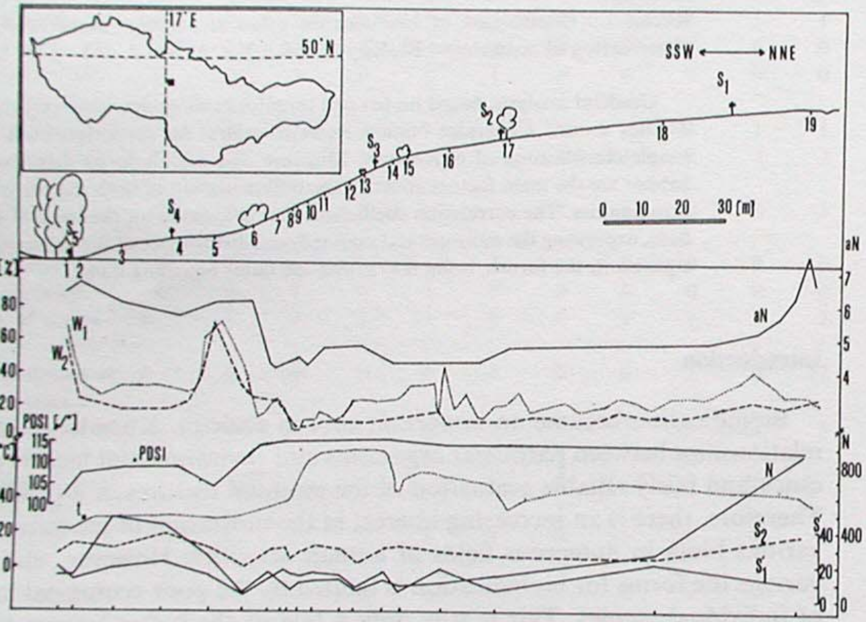

Fig. 1. Diagnostic representation of the transect in Čubernice N.R. and distribution of some characteristics of the biocoenoses and the habitats.
Top left: situation of the sample area in Czechoslovakia; numbers along the transect designate the location of the sample sites P-1 to P-19; S_1 to S_5 — location of microclimatic stations; aN — amount of nitrogen calculated according to Tsyganov (1983); PDSI — potential direct solar irradiation; t_0 — maximum temperature of the soil surface on June 5[th] and 6[th], 1982; N — total number of specimens of spiders collected in the pitfall traps in 1982; S' — number of species: S'_1 — number of species of vascular plants in the individual sites, S'_2 — number of spiders caught into pitfall traps in 1982; W_1 — soil moisture at a depth of 5 to 10 cm on April 13[th], 1982, expressed as percentage of dry mass; W_2 — the same on May 30[th], 1982.

Table 1. List of the sites under study

Designation of the site	Brief characterization
P-1	fragment of an alder carr
P-2	margin of an alder carr
P-3, P-4	mesic meadow
P-5	wetland influenced by washed-out fertilizers
P-6	shrub with *Prunus spinosa*
P-7	slightly xerothermic grassland
P-8 to P-12, P-14, P-16	xerothermic grassland
P-13, P-15	individual shrubs
P-17	solitary pines
P-18	dry pasture
P-19	nitrophilous margin of the pasture
R	secondary growth of *Robinia psedoacacia*
S	shrub with *Swida sanguinea* in the alluvium of a brook
B	subxerothermic grassland with *Bromus erectus*
F	xerothermic grassland with *Festuca rupicola*
A	recently invading xerothermic growth of *Arrhenatherum elatius*

Methods

In 1982 and 1983 parallel inventories of vascular plants and spiders (by means of pitfall traps, Tretzel, 1955) were carried out in 24 sample sites. At the same time, microclimatic and soil factors were monitored by the usual methods (Steubing, 1965). Nineteen sites were distributed along the above mentioned transect (P-1 to P-19), and other five locations in different types of vegetation in the vicinity of the transect, and designated according to the dominant plant species (see Tab. 1.). Significant characters of these sites based on the ordinal scale, are shown in Tab. 2. The species composition of the communities of vascular plants and spiders, which indicates the features of the sample sites, is presented in Tab. 3.

Position of the individual sites along the moisture gradient has been identified by the direct gradient analysis (Whittaker, 1967; Ellenberg, 1979) as an average of the indicator values based on the species composition. Relationships of individual plant species to environmental factors are given in Landolt (1977) (the calculation of index $X_{(2)}$) and Tsyganov (1983) (see Fig. 1). The hygrophility index $X_i^{(\alpha)} = \left(\sum_j f_{ij}\, i\right) \Big/ \sum_j f_{ij}$, where f_{ij} is the constancy of the species i in the community j, and j is the ordinal number of the community determined by the table analysis (Braun-Blanquet, 1964) for the region of the Hornomoravský úval (the Upper-Moravian Dale). These communities are arranged along the moisture gradient more or less linearly (Klimeš, 1983). For spiders, the hygrophility of the species occurring in the whole material in five or more specimens was expressed by index $X_i^{(\beta)} = \left(\sum_j X_{(2)} \cdot n_{ij}\right) \Big/ \sum_j n_{ij}$, where $X_{(2)}$ was the value of the moisture index, calculated for individual stands according to Landolt (1977), n_{ij} was the number of individuals of the species i trapped in the site j (Tab. 4). The moisture of stands was assessed by index $X_{(4)} = (2n_H + n_{HH})/(n_X + n_{HH} + n_H)$, where n_H is the number of xerophilous and xerobiotic species, n_{HH} is the number of hemihygrophilous and hemihygrobiotic species and n_H is the number of hygrophilous and hygrobiotic species. The hygrophility of spiders is mentioned by Tretzel (1952). The location of the sites in the temperature

Table 2. Characteristics of the sites and corresponding biocoenoses * — sites P-8 to P-14, P-16, A, F, the values in the table correspond to the degree or intensity of the characteristic (if two numbers are stated, they correspond to the minimum and maximum values)

Sites	1 2 5	3 4	7 B	*	18	19	S	6	17	15	R
Moisture	3	2	1	0	1	2	2	1	0	0	0
Nitrogen	2	1	0	0	1	3	1	1	0	0	1
Humus	1 2	1	0 1	0	0	0	0	0	1	0	1
Soil texture	2	1 2	1 2	0	0	1	0	0	0	0	0
Temperature	0	0	1	2	2	1	0	0	1	1	1
Light	0	1	1	2	2	1	0	0	1	0	0
Thickness of the soil profile	1	1	1	0	1	1	0	0	0	0	0
Slope inclination	0	0	1	2	1	0	0	1	1	1	1
Gravel frequency in soil	0	0	1	2	2	1	1	1	2	2	2
Stability of micro-climate	2	2	1	0	0	1	2	1	0	0	1
Fertilization	1	2	0	0	1 2	3	2	0	0	0	0
Grass mowing	0	2	1	0	1	2	0	0	0	0	0
Layers of vegetation	0 2	1	1	2	1	0	1	1	1	1	2
Representation of the tree layer	0 1	0	0	0	0	0	0	0	1	0	2
Representation of the shrub layer	1	0	1	1	0	0	2	2	0	2	1
Representation of the herb layer	2	3	3	1	1 2	2	0	0—1	1	0	1—2
Representation of mosses	1	1	2	3	2	0	0	1	0	0	1
Representation of lichens	0	1	2	0	0	0	0	0	1	0	1
Species richness of vascular plants	0	2	1 2	2	1	1	0	0	0	0	2
Species richness of spiders	1	1 2	1 2	0 2	0	1	1	0	0	1	2

gradient is expressed by the index $X_{(5)} = (S'_T - S'_P)/S'$, where S'_T is the number of thermophilous species, S'_P is the number of psychrophilous and S' is the total number of species of spiders in the site. Index $X_{(5)}$ is calculated on the basis of all the species whose indices of thermo-preference are known. A similar index $X_{(6)}$ is calculated only on the basis of species occurring in at least one site in three or more specimens (the ratio of the considered species with unknown thermo-preference indices will thus decrease to about one third). The placing of spiders into groups of thermophilous and psychrophilous species is mentined by Buchar (1972, 1975).

For about 10 to 25 % of species found in sampling sites their thermo-preference indices are not known (cf. Růžička, 1985); therefore a distortion must be assumed, which, however, can be

Table 3. Indicatively important species of vascular plants and spiders
With plants, the number of the sites is stated, in which the given species is present, a marked dominance is designated by the letter D; with spiders, mean numbers of specimens caught in one pitfall trap per one year; * — sites P-8 to P-14, P-16, A and F; $X_i^{(a)}$ — hygrophility index of the ith species of a vascular plant; $X_i^{(f)}$ — hygrophility index of the ith spider species; Y_i — indicative values of moisture of the ith species of a vascular plant; Z_i — index of thermopreference of the ith spider species — for details see text

Indices, sites	Y_i	$X_i^{(a)}$	1 2 5	3 4	7 B	*	18	19	S	6	17	15	R
Seseli osseum	1	1.13	.	.	.	7	.	.	.	.	.	.	.
Potentilla arenaria	1	1.40	.	.	1	9	.	.	.	.	.	.	.
Centaurea stoebe	1	1.92	.	.	.	7	.	.	.	.	.	.	.
Sedum acre	1	2.08	.	.	.	5	.	.	.	.	.	.	.
Campanula moravica	?	2.83	.	.	.	5	.	.	.	.	1	.	.
Thymus glabrescens	1	2.42	.	.	.	8	1	.	.	.	.	.	.
Dianthus carthusianorum	2	2.11	.	.	1	5	1	.	.	.	.	.	.
Eryngium campestre	2	2.56	.	.	.	5	1	.	.	.	.	.	.
Euphorbia cyparissias	2	2.44	.	.	2	6	1	.	.	.	.	.	1
Festuca rupicola	1	2.87	.	.	2	10	1	.	.	.	1	.	.
Galium verum	2	3.69	.	.	2	4	.	.	.	.	.	.	.
Pimpinella saxifraga	2	3.95	.	.	2	5	1	.	.	.	.	.	.
Arrhenatherum elatius	3	4.72	.	2	2	7	1	.	.	.	.	.	1
Taraxacum officinale agg.	3	6.48	.	2	.	.	1	1	.	.	.	.	.
Poa trivialis	3	7.67	3	.	.	.	.	.	1	.	.	.	1
Ranunculus repens	4	8.22	3	.	.	.	.	.	.	.	.	.	.
Robinia pseudoacacia			.	.	.	.	.	.	.	.	.	.	D
Rosa sp.			.	.	1	(D)	1	.	.	.	.	1	.
Ligustrum vulgare			.	.	.	.	.	.	.	.	.	D	1
Prunus spinosa			.	.	.	.	.	.	.	D	.	1	1
Swida sanguinea			1	.	.	1	.	.	D	.	.	1	1
Alnus glutinosa			(D)	.	.	.	.	.	.	.	.	.	.
Urtica dioica			2	.	.	.	.	D	.	.	.	.	1
Pinus sylvestris			.	.	.	.	.	.	.	.	D	.	.
Alopecosa accentuata	T	1.62	.	.	.	1	.	.	.	.	.	.	.
Zelotes pygmeus	?	1.66	.	.	.	1	.	.	.	.	.	.	.
Zelotes longipes	T	1.76	.	.	.	1	.	.	.	.	.	.	.
Evarcha laetabunda	T	1.77	.	.	.	1	.	.	.	.	.	.	.
Xerolycosa miniata	?	1.74	.	1	3	10	.	.	.	.	.	.	.
Zelotes hermanni	?	1.79	.	.	1	2	.	.	.	.	.	.	1
Alopecosa striatipes	T	1.83	.	.	1	2	.	.	.	.	.	.	1
Xysticus bifasciatus	N	1.89	.	1	2	2	.	.	.	.	1	.	.
Haplodrassus signifer	N	2.00	.	2	5	3	.	2	1	.	1	1	.
Alopecosa cuneata	N	2.05	3	11	12	16	30	20	3	1	4	2	3
Zelotes pusillus	N	2.14	.	1	2	1	1	1	.	1	.	1	.
Pachygnatha degeeri	N	2.58	5	102	32	3	5	61	2	.	28	.	1
Alopecosa pulverulenta	N	2.39	2	18	8	3	1	16	4	1	1	1	1
Pardosa pullata	N	2.39	5	77	60	5	.	7	3	2	2	1	.

Table 3. (Continue.)

Indices, sites	Z_i	$X_i^{(\beta)}$	1 2 5	3 4	7 B	*	18	19	S	6	17	15	R
Nothocyba subaequalis	?	2.47	1	17	2	0	·	·	3	1	5	·	·
Erigone dentipalpis	P	2.76	3	7	1	0	·	10	2	·	·	·	·
Diplostyla concolor	P	2.85	2	3	1	0	·	5	2	·	·	·	·
Pirata latitans	P	3.18	6	5	1	·	·	·	·	·	·	·	·
Pardosa amentata	P	3.41	3	·	·	·	·	·	·	·	·	·	·
Pirata hygrophilous	P	3.79	2	·	·	·	·	·	·	·	·	·	·
Pachygnatha clercki	P	3.60	9	·	·	·	·	·	·	·	·	·	·
Antistea elegans	P	3.51	8	·	·	·	·	·	·	·	·	·	·
Bathyphantes approximatus	P	3.67	6	·	·	·	·	·	·	·	·	·	·
Pardosa lugubris	N	2.46	·	1	1	·	·	1	18	·	2	·	10

Table 4. Spearman's correlation coefficients expressing the closeness of the relationships of selected characteristics of the individual sites

the arachnofauna comprises only the species caught into pitfall traps; all the correlations are significant for $P < 0.01$,

$X_{(1)}$ — soil moisture at a depth of 5 to 10 cm in percentage of dry mass (May 30, 1982);
$X_{(2)}$ — soil moisture determined by bioindication on the basis of the vegetation (Landolt, 1977);
$X_{(3)}$ — soil moisture determined by the direct gradient analysis of the vegetation;
$X_{(4)}$ — soil moisture determined by the direct gradient analysis of the arachnofauna;
$X_{(5)}$ — mean temperature of the stand determined by the direct gradient analysis of the arachnofauna for all the species present for which the thermo-preference indices are known;
$X_{(6)}$ — the same as $X_{(5)}$, but for the species which occur in at least one site in three or more specimens;
$X_{(7)}$ — amount of nitrogen in soil, determined by bioindication on the basis of vegetation (Landolt, 1977);
$X_{(8)}$ — man-induced disturbance determined on the basis of the vegetation;
$X_{(9)}$ — man-induced disturbance determined on the basis of the arachnofauna

	Moisture			Temperature			Man-induced disturbance	
	$X_{(2)}$	$X_{(3)}$	$X_{(4)}$	$X_{(5)}$	$X_{(6)}$	$X_{(7)}$	$X_{(8)}$	$X_{(9)}$
$X_{(1)}$	+0.904	+0.969	+0.907	−0.786	−0.758	+0.670	+0.751	+0.625
$X_{(2)}$		+0.969	+0.888	−0.876	−0.863	+0.794	+0.795	+0.670
$X_{(3)}$			+0.891	−0.782	−0.787	+0.754	+0.864	+0.696
$X_{(4)}$				−0.823	−0.807	+0.674	+0.667	+0.716
$X_{(5)}$					+0.854	−0.733	−0.664	−0.732
$X_{(6)}$						−0.814	−0.749	−0.692
$X_{(7)}$							+0.814	+0.622
$X_{(8)}$								+0.689

neglected, because such species occur only accidentally, and their linkage to the given habitat is uncertain. This assumption is confirmed by the fact that the correlations between indices $X_{(5)}$ and $X_{(6)}$ and the other indices shown in Tab. 4 do not substantially differ.

The degree of human impact is expressed by the index $X_{(8)} = (2n_{(1)} + n_{(2)})/N$, where $N = n_{(1)} + n_{(2)} + n_{(3)}$. The calculation of this index is based on vascular plants. N is the total number of species found in the given site, $n_{(1)}$ is the number of species occurring in the man-induced localities, $n_{(2)}$ is the number of species occurring in the localities slightly influenced by human's activity, and $n_{(3)}$ is the number of species in localities lacking human influence. A similar index $X_{(9)}$ has been created for the spiders too, where $n_{(1)}$ is the number of species occurring in the localities induced by different degree of human activity or lacking this impact, $n_{(2)}$ is the number of species occurring in the localities slightly influenced by human's activity or lacking this impact, and $n_{(3)}$ is the number of species only in localities lacking human impact. In spiders, the species of the first group are designated as expansive species, the species of the second group as "the relicts of the second order", and those of the third group as "the relicts of the first order" — Buchar (1972, 1983).

Direct measurements of some environmental factors (Figs. 1 and 5) were performed for the assessment of the effectiveness of the bioindication. The surface temperature was measured by a thermistor thermometer (Jeník and Kosina, 1960) on 5th and 6th June, 1982. The instantaneous soil moisture was determined as the percentage of the dry mass (Steubing, 1965) on 13th April and 30th May, 1982. The potential solar irradiance (Jeník and Rejmánek, 1969) was expressed in percentage of PDSI at the horizontal plane during the growing season. The thickness of the soil profile was measured by means of the puncture method according to Ramenskii (1952).

Ecofactors and bioindication

Knowledge of ecological requirements in vascular plants and spiders, i.e. two life forms belonging to different trophic levels in ecosystems, vascular plants being producers, spiders being consumers of the second or third order, offers a comparison of the results of bioindication in both groups.

The factors which determine the minimum floristic or faunistic resemblance among the sets of species in individual sites can be indicated as the main factors of differentiation in the given set of sites along the transect in the Čubernice N.R. It follows from the matrix of similarity coefficients (according to Sørensen, 1948) that the least floristic similarity is between the sites P-1, P-7 to P-14, and P-19, and the least similarity based on spiders is between the sites P-1, P-9 and P-19. It follows from the ecological analysis of the vegetation (according to Landolt, 1977) that the maximum of moisture, maximum amount of humus and maximum of fine soil particles are in P-1 site; the minimum of moisture is in the site P-9 (the amount of humus, presence of clay particles and the continentality are nearly at minimum, the light and heat almost at maximum). The maximum content of nitrogen in the soil is in the site P-19. The moisture gradient (soil texture and humus correlate quite closely with moisture) and the gradient of nitrogen as a representative of nutrients (in our case the latter gradient is identical with that of anthropogenic influence) can be considered decisive for the species composition of the flora of vascular plants and that of the arachnofauna in the locality under study. As it is evident from Figs. 2 and 3, mutual position of individual sites in the ordination scheme, expressing the relationships between the anthropogenic influence and moisture in the sites, is similar, no matter whether these factors are expressed on the basis of the flora (Fig. 2) or the arachnofauna (Fig. 3).

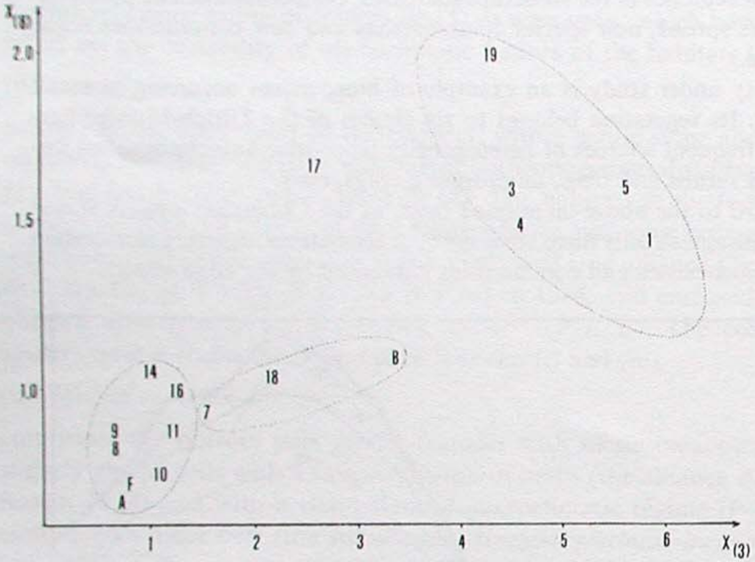

Fig. 2. Distribution of the sites in dependence on the moisture index $X_{(3)}$ and the index of man-induced disturbance $X_{(8)}$, calculated on the basis of species composition of the vegetation.

Position of the individual sites along decisive gradients of the environment was expressed by means of indices based on direct measurements and on the species composition of the flora and arachnofauna. The relationships between representative indices expressed by means of correlations are shown in Tab. 3. It is evident that there is a very close relationship between moisture and temperature in the investigated locality (see also Fig. 4). The correlation between temperature estimated from the vegetation analysis according to Landolt (1977) and that determined from the analysis of spiders ($X_{(5)}$, $X_{(6)}$) is even less close than the correlation between indices $X_{(2)}$ (soil moisture calculated by means of a direct gradient analysis of the vegetation) and $X_{(5)}$ (the temperature of the locality calculated by means of a direct gradient analysis of spiders).

Correlation between the soil moisture values estimated on the basis of vascular plants by the direct gradient analysis and by means of Landolt's tables (1977) is very close ($r_s = 0.969$). Relationship between the instantaneous soil

moisture and indices expressing the moisture ($X_{(2)}$, $X_{(3)}$, $X_{(4)}$) was, in the course of a year, the closest in the period of the highest temperatures and low precipitation (in 1982 at the end of May — see Figs. 1 and 5), which confirms unambiguously that these particular periods are decisive for the species composition of biocenoses in xerothermic habitats.

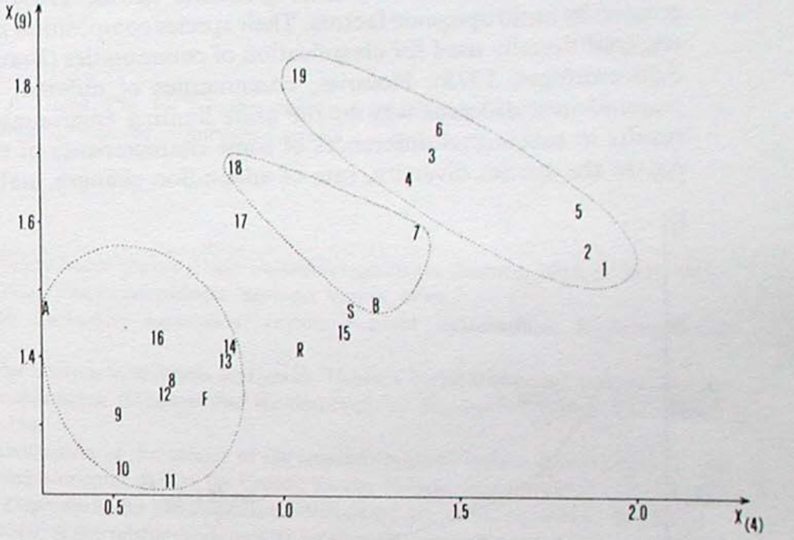

Fig. 3. Distribution of the sites in depencence on the moisture index $X_{(4)}$ and the index of man-induced disturbance $X_{(9)}$, calculated on the basis of species composition of the arachnofauna.

The degree of man-induced disturbance (see Tab. 2) is the second factor significantly participating in the differentiation of the habitats. It follows from the matrix of correlation coefficients (Tab. 3) that the relationships of the indices expressing the intensity of this factor are less close than those in the case of moisture and temperature indices. The reason is, above all, in different dynamics of plants and spiders. In this respect, vegetation is more conservative — adaptation and/or rearrangement of the community at quickly proceeding environmental changes demands more time.

The greatest differences between indices of anthropogenous influence ($X_{(8)}$ and $X_{(9)}$) are in the sites P-6, P-7, P-15, P-18, R, S, and A. All these plots are occupied by vegetation that can be classified, within the framework of the Zürich-Montpellier-System, only by using a deductive method of classification (Kopecký and Hejný, 1974). These growths are species unsaturated, disturbed, often fragmentary and quickly changing. However, the above-mentioned differences are, in some cases, caused partly by the edge effect, which is by far more expressive in the arachnofauna than in the flora; this fact is also confirmed by the logarithmic relationship of the similarity coefficiens of the flora and fauna in individual sites.

Classification

The possibility of classification of objects follows from their discontinuity. Considering only one time level, we can expect a discontinuous character of the biota along steep environmental gradients (Beals, 1969) which are mostly created by anthropogenic factors. Their species composition is a suitable character, traditionally used for classification of communities (Braun-Blanquet, 1964; Schwerdtfeger, 1975). However, communities of different trophic levels can respond in a different way to the same limiting environmental factor, which results in substantial differences of some characteristics of these communities, e.g. in the species diversity, rate of adaptation changes, stability, etc. (Brown,

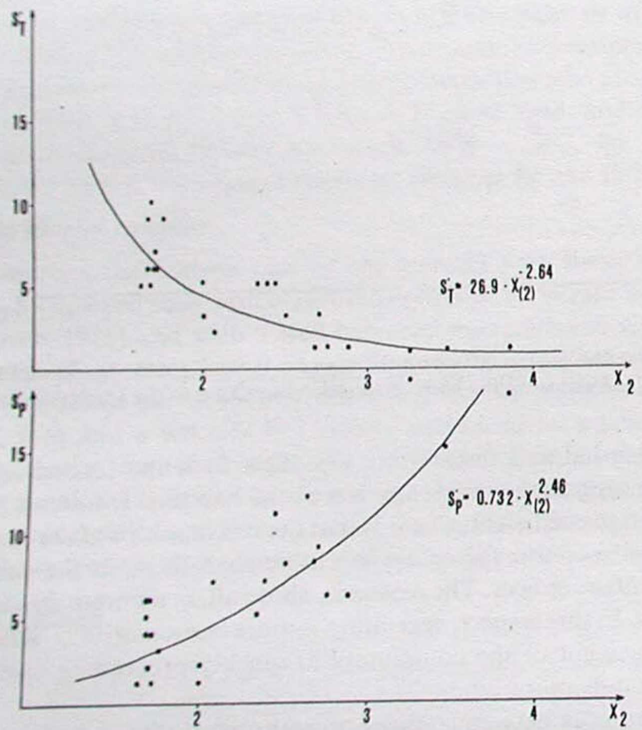

Fig. 4. Number of thermophilous — S'_T and psychrophilous — S'_P species of spiders in the individual sites, in dependence on the moisture $X_{(2)}$.

1984). That is why the relation "one phytocoenosis = one zoocoenosis" can be accepted only rarely, and why integrated classification of biocoenoses cause difficulty.

The cultural landscape of Central Europe has a mosaic character. Occurrence of the primeval biocoenoses is restricted to small patches only. This fact is especially well evident in "steppe" ecosystems, endangered by anthropogenic pressure, pauperization, unification and degradation (cf. Wolkinger, 1976). The expansion of "edge" communities at the expense of natural vegetation proceeds, importance of ecotones in the landscape increases. Numerous alien or previously rare species spread, new species combinations and new communities come into existence.

The locality under study is an example of biocoenoses occurring in small patches only. Its vegetation belongs to six classes of the Zürich-Montpellier-School with frequent sources of heterogeneity (spot-wise anthropogenous impact, isolated shrubs and trees, outcropping crags, etc.).

With regard to the above-mentioned facts, at the Čubernice locality it was possible to distinguish only three basic types of ecosystems, covering also certain small-scale biocoenoses and communities influenced by the edge effect:

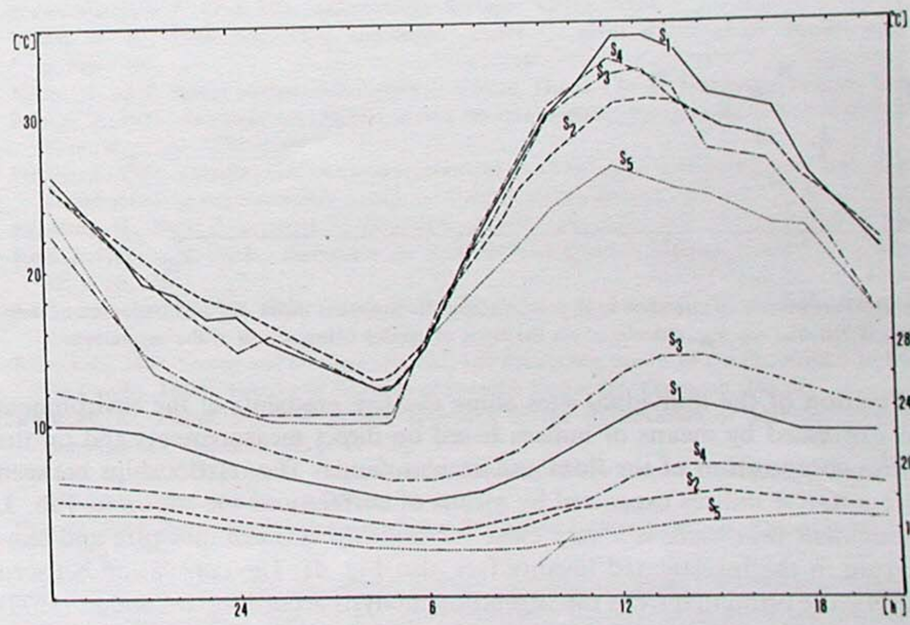

Fig. 5. Daily course of the temperature at a height of 0.5 m and a depth of 0.05 m along the transect on June 5[th] and 6[th], 1982. S_1 to S_5 — microclimatic stations — see Fig. 1; above — air temperature (left scale), below — soil temperature (right scale).

(i) *Colluvial complex*

includes dry, sunlit SSW slopes with shallow, heavily skeletal ranker soils, with sparse vegetation of the herb layer and richly developed moss and lichen layers (the initial communities of the alliance *Koelerio-Phleion* Korneck 1974) with a poor to rich fauna of spiders without significant dominances (P-8 to P-14, P-16, A, F). On deep brown rankers, there occur communities of shrubs, with a relatively poor fauna of spiders (P-15) or even trees, which have a favourable effect on the equability of microclimatic factors of the habitats (P-17, R).

(ii) *Eluvial complex*

comprises the upper part of the transect, with a gentle slope and a soil of the oligotrophic brown soil type, with larger anthropogenous disturbance caused by grazing, fertilization and mowing (P-18). The habitats at the foot of the slope are similar. The soil here is of the oligotrophic to eutrophic brown soil type, the vegetation of vascular plants is richly developed (the alliance *Cirsio-Brachypodion* Hadač et Klika in Klika et Hadač 1944, and enclosed lawns of the alliance *Koelerio-Phleion* Korneck 1974 — P-7, B). The communities of spiders have a transitional character between (i) and (iii).

(iii) *Illuvial complex*

comprises the bottom part of the transect with mesic meadows on alluvial, slightly gleyed soils with a rich vegetation of herbs (the alliance *Arrhenatherion* Koch 1926) and with a well-balanced microclimatic régime (P-3, P-4), fragments of an alder carr (the suballiance *Alnenion glutinoso-incanae* Oberdorfer 1953) in the vicinity of a brook (P-1), its margins (P-2), adjacent shrubs (S, P-6) and a wet site P-5 heavily influenced by washed-out fertilizers. This group also approaches the site P-19, where, on a relatively dry brown soil overfertilized with nitrogen, the original plant communities have been displaced by a nitrophilous growth of *Urtica dioica*. Here, the communities of spiders are rich in species, with several significantly dominant species.

Conclusion

An inventory of vascular plants and spiders was performed in the vicinity of Čubernice N.R., central Moravia. Nineteen sites along a transect made across the SSW slope of a valley comprised a fragment of an alder carr, mesic meadow, ruderalized pasture and xerothermic grassland. Six sites were in other types of vegetation in the vicinity of the transect. The features of the sites were estimated both by direct measurements of factors of the habitat, and by a direct gradient analysis of vascular plants and spiders. The correlations of the indices of moisture and the anthropogenous disturbance, calculated on the basis of species composition of the vegetation and the arachnofauna, were very close (0.875 for moisture, 0.689 for anthropogenous disturbance). A simple classification, applicable to both investigated communities, corresponds to the grouping of the catena into eluvial, colluvial and illuvial complexes.

Translated by Ing. V. Dufková

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Klimeš L.: **Srovnání bioindikace cévnatých rostlin a pavouků v klasifikaci ekosystémů.**

Na základě inventarizace pavouků a cévnatých rostlin na 24 plochách v SPR Čubernice (střední Morava) byla provedena jednoduchá klasifikace ekosystémů, použitelná pro obě studované skupiny organismů. Hlavními faktory, určujícími diferenciaci společenstev rostlin i pavouků, byla vlhkost a míra antropického narušení. Korelace indexů vyjadřujících vlhkost, resp. antropické narušení stanovišť vypočítaných na základě flóry a arachnofauny jsou vysoce průkazné ($r_S = 0{,}875$, resp. 0,689, $P < 0{,}01$).

Климеш Л.: **Оценка биоиндикации сосудистых растений и пауков в классификации экосистем.**

Недалеко государственного заповедника Чубернице, центральная Моравия, на трансекте идущем через откос долины я изучал отношение растительности и пауков к некоторым факторам среды.

Положение отдельных пунктов в решающих градиентах влажности почвы и антропогенного нарушения я назначил прямым измерением этих факторов и прямым градиентным анализом.

Корреляции индексов, которые выражают позицию пунктов в этих градиентах, вычисленных на основе растительности и пауков, были тесны. Для влажности почвы существует коэффициент корреляции $p = 0{,}875$, для антропогенного нарушения $p = 0{,}689$. Несмотря на то, что ряд параметров сопоставляемых сообществ сосудистых растений и пауков не зависит друг от друга, удалось создать простую классификацию экосистем, которая соотвествует обеим изучаемым таксономическим группам.