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Epigeic spiders as an indicator system to evaluate biotope quality of riversides and floodplain grasslands on the river Ilm (Thuringia)

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Abstract. Six different stands of floodplain grassland along the river Ilm were investigated by the barber trap method within the federal research project (BMFT) "Ecologically justified conception for the redevelopment of the river Ilm (Thuringia) aiming at the extensive renaturation of the river and its floodplain".

Starting from largely well-known ecological demands (ecological potency) of selected epigeic spider species or species groups it is possible to manage the evaluation of biotope quality and fragmentation. This ecological data basis makes it possible to draw individual conclusions from qualitative and quantitative structural parameters of the site-specific spider coenosis to the structural and physiological environmental situation and therefore the biotope quality of the special site.

The evaluation of the degree of original nature from different floodplain stands serves as a technical basis for area related planning within the redevelopment measures of the river Ilm and its floodplain. The indicated determined information will be submitted to an aptitude test concerning prognosis of potential consequences of future projects, conclusion of necessary ecological compensation measures or sucessful control within the framework of biomonitoring.

INTRODUCTION

The problem area of bioindicative evaluation of biotopes is extensive discussed by Usher and Erz (1994) and Blandin (1986). Furthermore, Hänggi (1987), Maelfait et al. (1989), Mulhauser (1990) and Fürst et al. (1993) give critical descriptions concerning utilization of spiders as ecological indicators.

Ecological investigations with selected terrestrial arthropod groups should be carried out in the framework of the elaboration of an evaluation catalogue concerning features of the terrestrial zone from a river system of the Ilm-type (rivulet). Starting from a structure of site-specific epigeic spider coenosis should be analysed with the help of agglomerative and divisive classification methods. Furthermore, it was a main objective of this investigation to find out to which degree environmental parameters registered can help to explain the species composition of each sampling site. In this process, attention was focussed on the differentiation between natural and anthropogenous factors aiming at the elaboration of an ecolocically justified conception for the extensive renaturation of the river and its floodplain.

MATERIAL AND METHODS

The Ilm is a little river which rises in three main springs in the Thuringian Forest and flows into the river Saale after 125 km stream distance. The altitude is between 700 and 600 m in the boulder zone (mountainous) and approximately 100 m in the confluence region with the Saale. Therefore, the Ilm is a very fast-running rivulet with an outflow from 2.4 to 6 m^3/s in the middle of the year. Floodwater with maximal outflows of more than 100 m^3/s are very rare (two or three flood occurences per 100 years). The river Ilm is characterised by a single river bed and runs through four geological formations. The geological underground of the rivershed consists of granite in the upper boulder zone (site A), Bunter Sandstone in the lower region of the mountain zone (site B), coquina formation with limestone rocks dominates the middle part (site C, D, E) but Keuper the under, very droughty area (site F). There is a humid area in the upper region. The more droughty area in the lower part has its maximum in the region of site F.

Nearly continuous small wooded riversides and adjoining intensive or extensive grasslands are to be characteristic of the Ilm and its floodplain area.

The choice of our investigation sites comes from three gradients: (1) the regional gradient as representative distribution along the river zones; (2) the natural gradient concerning climate and geological underground; (3) the exploitation gradient concerning anthropogenous cultivation.

Six different stands of floodplain grassland along the river Ilm were investigated by pitfall trap method over one season (April to October) in 1992 (Ilm rivershed and location of the sampling sites see Fig. 2).

Fig. 1 shows the plan of one ecotone sampling transect consisting of six pitfall traps per site: three traps in the grassland along the wooded riverside (with shadow at times) and three traps into the adjoining open grassland). We used 5% formaldehyde solution as catching liquid and realised an emptying rythm of 14 days. Moreover, we registered a set of selected direct and indirect measured parameters concerning the environmental situation of the special sites and their surroundings. Altogether, 31 parameters with conceivable formative influence on coenosis structure were selected for our analysis; concerning soil (pH, particle size distribution, water holding capacity, chemical components like K, P, Ct, Nt, and Ct/Nt-proportion, furthermore floodplain level above river level as approximate value related to the groundwater level); concerning climate (amount of precipitation, temperature, altitude); concerning vegetation (proportion of flood indicating plant species, ecological plant class groups in the vegetation cover, vegetation structure as standardized vegetation canopy); and concerning natural equipment [biotope diversity (calculation see legend Table 2) and exploitation index as degree of intensity of anthropogenous cultivation 100 m around the transect, related to the area] (see also Table 2). The vegetation parameters come from methods or programs of Barkmann (1988), Bemmerlein and Fischer (1985) and Spatz et al. (1979).

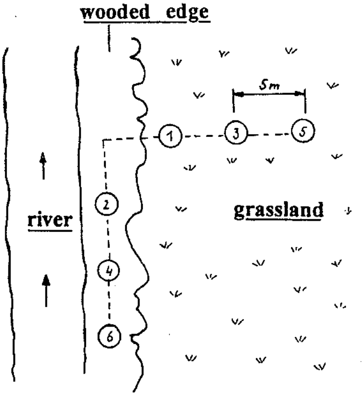


Fig. 1. Plan of a sampling site (pitfall trap transect).

Data analysis was realized in three main steps:

☐ Ecological situation analysis with structure, species trimming and composition of site specific epigeic spider coenosis, their species traits, and especially in abundance and dominance of floodplain typical epigeic spider species (dominance level or presence of steno-ecic hygrophilous species). The division of spider species into ecological groups follows bibliographical references to Maurer and Hänggi (1990), Heimer and Nentwig (1991) and Wiehle (1956, 1960);

☐ Classification analysis for site similarity concerning epigeic spider coenosis with agglomerative (Ward method) (see Jongman et al., 1987) and divisive (TWINSPAN) (see Hill, 1979) clustering methods;

☐ Canonical Correspondense Analysis (CCA) (see Ter Braak, 1985) to show the main connections between the structure of spider coenosis and the natural and anthropogenous equipment of the site's surrounding area.

RESULTS, CONCLUSIONS AND DISCUSSION

The proportion of stenoecic hygrophilous, floodplain typical species is obviously naturally highest in the boulder zone or spring region (site A). This proportion of especially valuable species in floodplain biotopes decreases along the ecocline river in favour of mesic ones (with the exception of the obviously "disturbed" site B). Hygrophilous species reach a second maximum in site C. They are most decreased in site F. Moist meadow species are most frequent within the hygrophilous ones. Exploitation tolerant mesic meadow species and partly ubiquitous ones reached their maximum in site F. Typical floodplain forest species are underrepresented because the wooded area along the river banks is mostly very small and only as an exception extensively distinct. Instead there are many species of mesic hardwood forests and woody mantels. The spider coenosis of the transect area is to be characterised as a typically ecotonal community. More xerothermic species obviously naturally occur in small numbers in all sites investigated.

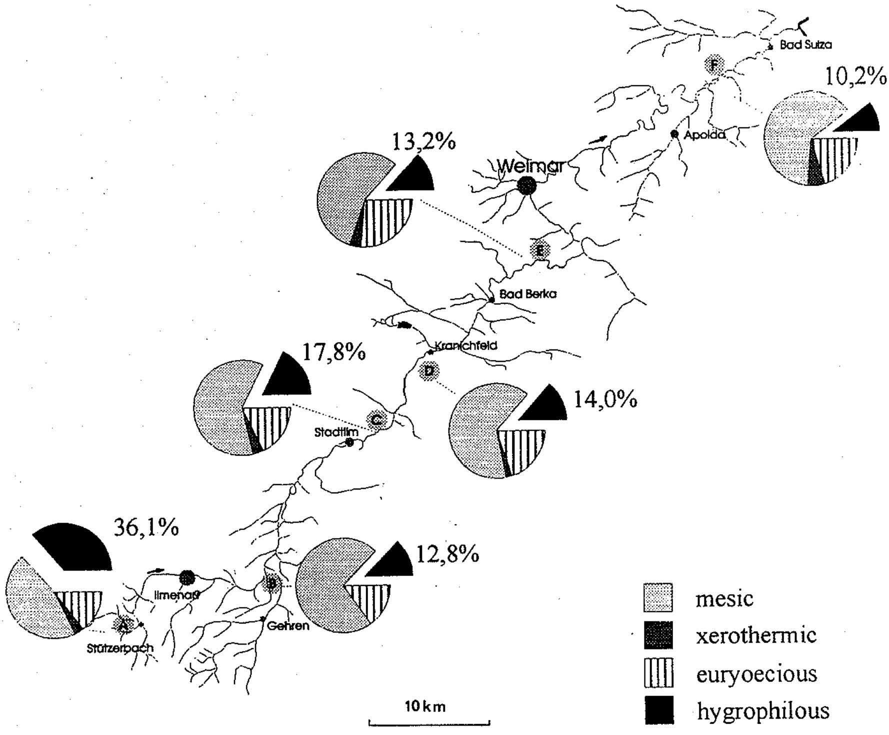


Fig. 2. Preference of moisture in the epigeic spider coenosis (% species).

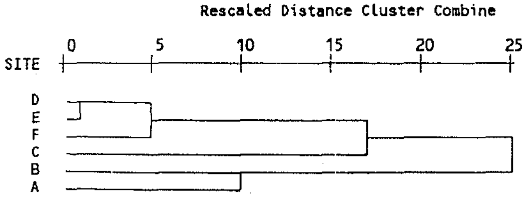
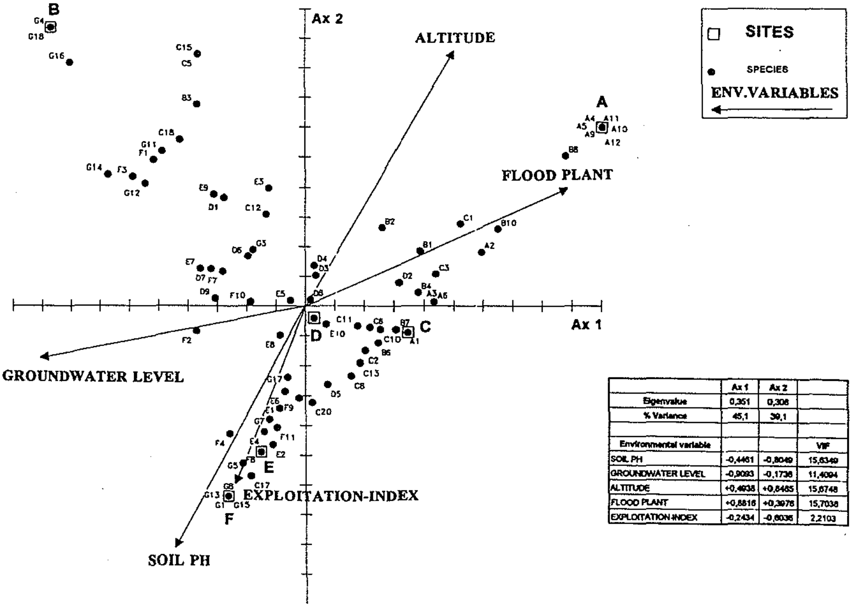


Fig. 3. Dendrogram of site similarity (WARD method) concerning epigeic spider coenosis. Ln (abundance + 1), species with abundance > 1.

They may be evaluated as regionally typical concomitants of the Ilm floodplain. The even pattern of the proportions between the distinguished ecological groups of spiders does not change in considerable magnitudes, if the proportion of individuals is considered instead (i.e. when each species is weighted by ist number of individuals.

The dendrogram in Fig. 3 shows a clearly visible classification into three site groups on the basis of logarithmic abundances of 93 species with abundance > 1.

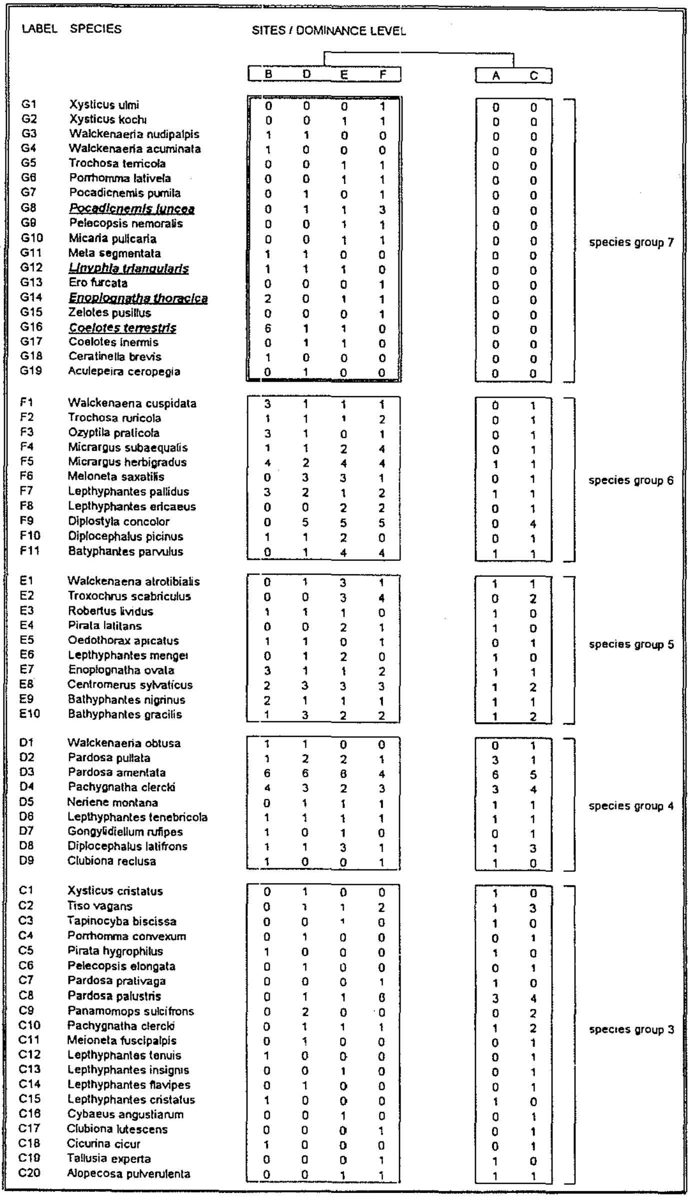


	Ax 1	Ax 2	
Eigenvalue	0,351	0,308	
% Variance	45,1	39,1	
Environmental variable			VIF
SOIL PH	-0,4461	-0,8049	15,6349
GROUNDWATER LEVEL	-0,9093	-0,1736	11,4094
ALTITUDE	+0,4938	+0,8465	15,6748
FLOOD PLANT	+0,8816	+0,3976	15,7036
EXPLOITATION-INDEX	-0,2434	-0,6036	2,2103

Fig. 4. Triplot of the Canonical Correspondense Analysis (CCA) of spider coenosis to natural and anthropogenous environmental factors.

Table 1. Results of Two Way Indicator Species Analysis (TWINSPAN). All species with n > 1 (93). Six pseudospecies cut level (TINSPAN).

Dominance class	0	1	2	3	4	5	6
Dominance cut level	absence	< 1%	< 2%	< 5%	< 10%	< 20%	>20%



LABEL	SPECIES	SITES / DOMINANCE LEVEL						
		B	D	E	F	A	C	
G1	Xysticus ulmi	0	0	0	1	0	0	
G2	Xysticus kochi	0	0	1	1	0	0	
G3	Walckenaeria nudipalpis	1	1	0	0	0	0	
G4	Walckenaeria acuminata	1	0	0	0	0	0	
G5	Trochosa terricola	0	0	1	1	0	0	
G6	Porrhomma lativela	0	0	1	1	0	0	
G7	Pocadicnemis pumila	0	1	0	1	0	0	
G8	***Pocadicnemis juncea***	0	1	1	3	0	0	
G9	Pelecopsis nemoralis	0	0	1	1	0	0	
G10	Micaria pulicaria	0	0	1	1	0	0	species group 7
G11	Meta segmentata	1	1	0	0	0	0	
G12	***Linyphia triangularis***	1	1	1	0	0	0	
G13	Ero furcata	0	0	0	1	0	0	
G14	***Enoplognatha thoracica***	2	0	1	1	0	0	
G15	Zelotes pusillus	0	0	0	1	0	0	
G16	***Coelotes terrestris***	6	1	1	0	0	0	
G17	Coelotes inermis	0	1	1	0	0	0	
G18	Ceratinella brevis	1	0	0	0	0	0	
G19	Aculepeira ceropegia	0	1	0	0	0	0	
F1	Walckenaeria cuspidata	3	1	1	1	0	1	
F2	Trochosa ruricola	1	1	1	2	0	1	
F3	Ozyptila praticola	3	1	0	1	0	1	
F4	Micrargus subaequalis	1	1	2	4	0	1	
F5	Micrargus herbigradus	4	2	4	4	1	1	
F6	Meioneta saxatilis	0	3	3	1	0	1	species group 6
F7	Lepthyphantes pallidus	3	2	1	2	1	1	
F8	Lepthyphantes ericaeus	0	0	2	2	0	1	
F9	Diplostyla concolor	0	5	5	5	0	4	
F10	Diplocephalus picinus	1	1	2	0	0	1	
F11	Batyphantes parvulus	0	1	4	4	1	1	
E1	Walckenaeria atrotibialis	0	1	3	1	1	1	
E2	Troxochrus scabriculus	0	0	3	4	0	2	
E3	Robertus lividus	1	1	1	0	1	0	
E4	Pirata latitans	0	0	2	1	1	0	
E5	Oedothorax apicatus	1	1	0	1	0	1	species group 5
E6	Lepthyphantes mengei	0	1	2	0	1	0	
E7	Enoplognatha ovata	3	1	1	2	1	1	
E8	Centromerus sylvaticus	2	3	3	3	1	2	
E9	Bathyphantes nigrinus	2	1	1	1	1	1	
E10	Bathyphantes gracilis	1	3	2	2	1	2	
D1	Walckenaeria obtusa	1	1	0	0	0	1	
D2	Pardosa pullata	1	2	2	1	3	1	
D3	Pardosa amentata	6	6	6	4	6	5	
D4	Pachygnatha clercki	4	3	2	3	3	4	
D5	Neriene montana	0	1	1	1	1	1	species group 4
D6	Lepthyphantes tenebricola	1	1	1	1	1	1	
D7	Gongylidiellum rufipes	1	0	1	0	0	1	
D8	Diplocephalus latifrons	1	1	3	1	1	3	
D9	Clubiona reclusa	1	0	0	1	1	0	
C1	Xysticus cristatus	0	1	0	0	1	0	
C2	Tiso vagans	0	1	1	2	1	3	
C3	Tapinocyba biscissa	0	0	1	0	1	0	
C4	Porrhomma convexum	0	1	0	0	0	1	
C5	Pirata hygrophilus	1	0	0	0	1	0	
C6	Pelecopsis elongata	0	1	0	0	0	1	
C7	Pardosa prativaga	0	0	0	1	1	0	
C8	Pardosa palustris	0	1	1	6	3	4	
C9	Panamomops sulcifrons	0	2	0	0	0	2	
C10	Pachygnatha clercki	0	1	1	1	1	2	species group 3
C11	Meioneta fuscipalpis	0	1	0	0	0	1	
C12	Lepthyphantes tenuis	1	0	0	0	0	1	
C13	Lepthyphantes insignis	0	0	1	0	0	1	
C14	Lepthyphantes flavipes	0	1	0	0	0	1	
C15	Lepthyphantes cristatus	1	0	0	0	1	0	
C16	Cybaeus angustiarum	0	0	1	0	0	1	
C17	Clubiona lutescens	0	0	0	1	0	1	
C18	Cicurina cicur	1	0	0	0	0	1	
C19	Tallusia experta	0	0	0	1	1	0	
C20	Alopecosa pulverulenta	0	0	1	1	1	1	

Table 1. (cont.)

B1	Oedothorax retusus	1	4	2	0	6	4	species group 2
B2	Lepthorhoptrum robustum	1	1	1	0	2	3	
B3	Gonatium rubens	1	0	0	0	1	1	
B4	Erigonella hiemalis	0	0	1	0	1	1	
B5	Erigone atra	1	1	0	1	1	4	
B6	Dicymbium nigrum	0	1	1	3	2	4	
B7	Centromerita bicolor	0	0	1	0	1	1	
B8	Araeoncus humilis	0	0	1	0	2	0	
B9	Allomengea vidua	0	1	0	0	1	1	
B10	Allomengea scopigera	0	0	1	0	1	1	
A1	Walckenaeria capito	0	0	0	0	0	1	species group 1
A2	***Tochosa spinipalpis***	0	0	0	0	1	1	
A3	***Pirata piraticus***	0	0	0	0	1	3	
A4	Pelecopsis mengei	0	0	0	0	1	0	
A5	Oedothorax gibbosus	0	0	0	0	1	0	
A6	***Oedothorax fuscus***	0	0	0	0	1	1	
A7	Oedothorax agrestis	0	0	0	0	1	0	
A8	Metopobactrus prominulus	0	0	0	0	1	0	
A9	Lophomma punctatum	0	0	0	0	1	0	
A10	***Gongylidiellum vivum***	0	0	0	0	2	0	
A11	Drepanotylus uncatus	0	0	0	0	1	0	
A12	***Diplocephalus permixtus***	0	0	0	0	4	0	
A13	Diplocephalus cristatus	0	0	0	0	1	0	
A14	Cnephalocotes obscurus	0	0	0	0	1	0	
		site group 1				site group 2		

The sites D, E and F form the first group, in which the limestone sites D and E in the middle part of the river are highly similar concerning their epigeic spider coenosis. A second group forms the sites A and C. Both investigation sites are characterised by the highest proportion of (mutual) hygrophilous species. Last but not least we have a third group comprising site B. The epigeic spider coenosis of this sampling site must be evaluated as disturbed concerning their coenosis structure and species composition. Obviously the former extraction of gravel and the deposit of the overlay shelf in the actual transect area are the main reasons for the indicated disturbance.

The results of divisive classification (TWINSPAN) are largely confirmed by the agglomerative ones (WARD method) (Table 1).

Two site groups and seven species groups are formed in the outcome of the analysis. The latter show increasing meaningfulness for site group differentiation in direction to the periphery. Spiders of species group 1 (label A1—A14) are mostly hygrophilous ones indicating a high moisture status of site group 2 (A and C). At the other end of Table 1, species group 7 comprises species which are only abundant in the stands of site group 1 (B, D, E and F). Here are especially mesic spider species which prefer ecotonal biotopes and also more drought-adapted and/or exploitation tolerant ones.

Assumingly, on reflexion of the ecological demands of the spider species in the highly exposed groups of Table 1, a moisture gradient has the main formative influence on floodplain spider coenosis. As a result of the Canonical Correspondense Analysis (CCA) with site specific environmental parameters (Table 2) shown in Fig. 4, this assumption can be supported and reaffirmed.

Table 2. Environmental parameters of the sampling sites. Comments to Units of Measuring: (1) Kx assumed all soil (particle size) fractions in % multiplied with a fraction coefficient x (gravel = 0.08, sand = 0.07 to 0.05, silt = 0.04 to 0.02, clay = 0.01); (2) Vx after Barkman (1988) as standardized mean vegetation canopy expressed in vertical covering; (3) Hx after Barkman (1988) as standardized mean vegetation canopy expressed in horizontal covering; (4) The calculation of biotope diversity orientates on the Shannon—Weaver formula for diversity with $P_i = A_i/A$, A_i = area of biotope i and A = area of all biotopes in a circle of 100 m around the trap transect (distinguished biotope types: reeds, shingle plant communities and gravel banks, "softwood" floodplain forest, "hardwood" floodplain forest, mixed hardwood forest (hanger), coniferous forest, bushes and shrubs, wet abandoned meadows, fresh abandoned meadows, xerotherm grasslands, ruderal vegetation, wet extensive grazing meadows, meadows with intensive pasture management, agricultural cropland); (5) The exploitation-index is estimated as the sum of exploitation intensity (graduation from 1 = unused to 5 = high) multiplied with the area % of each biotope in a circle of 100 m around the trap transect /100.

No.	Parameter	Unit of Measuring	Label	Sites					
				A	B	C	D	E	F
	SOIL								
1	PH		SOIL PH	4,33	5,72	6,7	6,87	7	7,07
2	Water-holding capacity	mm water/dm soil	WATERHC	53	44	50	58	50	54
3	Vertical porosity	air permeability (PF2,5)	VPOROS	2,78	2,3	2,9	2,5	2,7	2,3
4	Texture index (Kx)	1)	TEXTURE-INDEX	8,59	6,02	4,81	3,37	4,21	3,14
5	K	mg/100g soil	K	11	13	18	7	7,5	7
6	P	mg/100g soil	P	2,25	2,7	13,55	0,95	2,75	7,93
7	Nt	%	N	0,42	0,17	0,27	0,19	0,16	0,19
8	Ct	%	C	4,95	2,15	2,6	1,7	1,6	2,2
9	Ct / Nt - proportion		CN	12	12,5	10	9	10	11
10	Floodplain level above mean Ilm water level (=groundwater level below floodplain surface)	m	GROUNDWATER LEVEL	0,1	2	0,4	1	1,3	2
11	Flooding dynamics	yes=1; no=0	FLOOD DYN	1	0	0	0	0	0
	KLIMA								
12	Precipitation (long-yearly mean)	mm	PRECIPITATION	1000	700	560	645	593	550
13	Temperature (long-yearly mean)	°C	TEMPERATURE	6	6,9	7,2	7,1	7,8	8
14	Altitude	m	ALTITUDE	610	424	333	305	260	140
	VEGETATION								
15	Number of taxa	n	TAXA	53	34	46	54	48	40
16	Flood indicating plant species	% (species)	FLOOD PLANT	12,8	1,9	5,5	6,7	3,4	1
17	Moisture change indicating plant species	% (species)	MOISTURE-CHANGE	22,4	9,4	7,9	5,9	4,3	10
	Ecological plant class groups								
18	Companions	% (species)	COMP	5,6	3,7	3,9	3	2,6	0
19	Fresh water and moor vegetation	% (species)	MOOR	19	0	2,4	3	0,9	1
20	Herbaceous vegetation of often disturbed stands	% (species)	HERBA	9,6	52,9	45,7	50,4	48,3	71
21	Anthropo-zoogene heathlands and pastures	% (species)	PASTURE	55,4	24,6	21,3	21,5	20,7	21
22	Perennial herb border vegetation and bushes	% (species)	HERB BORDER	0,7	0	0	0	0,9	0
23	Harwood forests and related plant communities	% (species)	FOREST	9,6	18,8	26,8	22,2	26,7	7
	Stand indicator amount of the vegetation								
24	Lightness (mean)		LIHGT	6,6	6,1	6	6,2	6	6,7
25	Moisture (mean)		MOIST	7,4	5,6	5,7	5,9	5,6	5,5
26	N-amount (mean)		N-AMOUNT	5,2	7,3	7,3	7,3	7,3	7,4
	Vegetation structure								
27	Standardized mean of the vegetation canopy Vx	2)	VX	22,24	35,07	30,39	26,39	30,53	22,42
28	Standardized mean of the vegetation canopy Hx	3)	HX	22,26	44,94	33,44	27	29,95	25,79
	NATURAL EQUIPEMENT (100m radius)								
29	Number of biotops	n	BIOTOPE-N	4	9	10	7	8	4
30	Biotope diversity	4)	BIOTOPE-DIV	0,89	1,76	1,84	1,16	1,52	1,11
31	Exploitation index (intensity of anthropogenous cultivation)	5)	EXPLOITATION-INDEX	2,51	2,76	3,17	2,37	3,69	3,14

We are able to reveal 5 parameters as "key factors" for the pattern, which we found in the spider species composition and distribution along the river Ilm, because of their high correlation coefficients to the first of both main axes in outcome of the CCA, shown in the table of Fig. 4 (from altogether 31 environmental parameters with ecologically conceivable influence to the epigeic spider coenosis, shown in Table 2).

These five parameters are significant statistically relevant for the explanation of 84% of the variance in our spider species data set. The remaining variance, especially along the third main axis (not shown in Fig. 4) in direction to site B, cannot be explained clearly by one of the environmental parameters included in our data analysis.

The triplot of the CCA shows that epigeic spider coenosis is especially reacting to soil moisture conditions. In this regard, effects of the groundwater level below the floodplain soil surface (**groundwater level**) and/or naturally flooding dynamics (here as indirect measured parameter named "**flood plant**" as % cover of flood indicating plant species) have the main formative influence on coenosis structure (highest correlation with the first main axis reflecting the highest species variance in our data set, see also Table 2). At the same time it is possible to identify indicator species groups for both, general floodplain typical moisture conditions and especially flood dominated areas in the floodplain (like the boulder zone in site A). Sites with intact (natural) flooding dynamics and groundwater near the soil surface (site A) are indicated by the species group *Gongylidiellum vivum* (A10), *Pelecopsis mengei* (A4), *Oedothorax gibbosus* (A5), *Lophomma punctatum* (A9), and *Diplocephalus permixtus* (A12). A second species group with preferences for more open (exposed), wet habitats is characteristic of regions with a low floodplain level in relation to the river water level and therefore surface near groundwater also without flooding dynamics, for instance species like *Trochosa spinipalpis* (A2), *Oedothorax fuscus* (A6), *Pirata piraticus* (A3), and *Allomengea scopigera* (B10). The other end of the moisture gradient is indicated by species like *Coelotes terrestris* (G16), *Enoplognatha thoracica* (G14) and *Linyphia triangularis* (G12).

How we have to interpret the high correspondense of the parameter **soil pH** with the species variance along the second main axis of the analysis is still an open question.

Independent of, it seems reasonable to assume that this may be interpreted as an effect of correlation between the gradients of the parameters "**altitude**" and "**soil pH**", which are in reciprocal relationship (see Table 2).

It is obvious, however, that spider coenosis in the second appeal is influenced by the altitude gradient (**altitude**), which has a formative effect concerning temperature and precipitation factors (distribution and amount per year).

Moreover, the influence of exploitation intensity (**exploitation-index**) in the surrounding region of our investigation sites can be indicated in the third appeal by structural changes in the coenosis but also by the presence and dominance level of individual spider species, which are well known as exploitation tolerant [for instance *Pocadicnemis juncea* (G8), and *Zelotes pusillus* (G15)].

Furthermore, two examples will be discussed, demonstrating the suitability of epigeic spiders as an indicator system for the biotope quality of floodplain stands.

We are able to reveal one common spider species as an indicator for the moisture status of exposed biotopes near water as a result of an extensive analysis within the framework of our study.

Fig. 5 shows the dominance level of *Oedothorax retusus* in our sampling sites, which are highly correlated with the site specific moisture status of the floodplain stands. This generally common linyphiid spider is described as mesic hygrophilous moist meadow species with preference for exposed biotopes close to water (Wiehle, 1960; Maurer & Hänggi, 1990; Heimer & Nentwig, 1991). Therefore the dominance level of this epigeic spider species obviously indicates the site specific moisture conditions in our floodplain stands. These in turn are groundwater dependent and/or precipitation or flood influenced. The highest dominance level is reached in the humid boulder zone (site A) with intact flooding dynamics and a groundwater level close to soil surface. A second maximum is shown in sites D and C in the middle part of the river region. The mesic moisture conditions which mainly came from a mean groundwater level < 1 m below floodplain are also obviously possible habitat conditions for *Oedothorax*

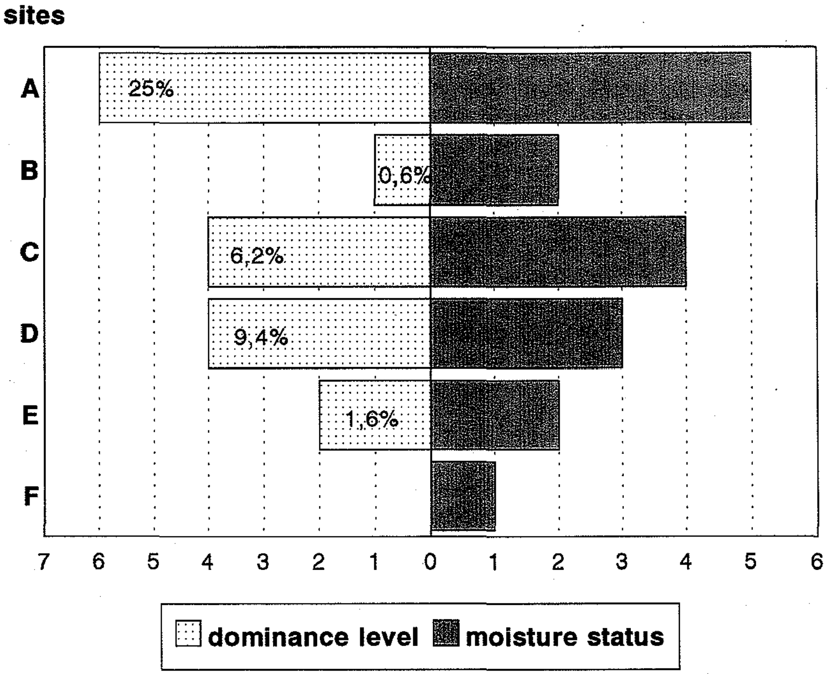


Fig. 5. *Oedothorax retusus* (Linyphiidae) as an indicator of the moisture status of floodplain grasslands. Dominance level see legend Table 1. Moisture status: 1—dry, low precipitation (< 550 mm per year), groundwater level > 2 m below floodplain (F); 2— fresh, precipitation input of about 600 mm/year with a groundwater level of approximately 1m (E) or precipitation input of about 700 mm per year and groundwater level > 1.5 m below floodplain (B); 3—mesic, precipitation input of about 650 mm per year and groundwater level of approximately 1 m below floodplain (D); 4—humid, weir modified, surface near groundwater conditions with precipitation of about 560 mm per year (C); 5—wet, surface near groundwater (spring region) intact flooding dynamics, precipitation input of about 1000 mm per year (A).

retusus. Their dominance levels within the epigeic spider coenosis have obviously decreased in sites with a groundwater level > 1 m below floodplain and the species is missing in low-precipitation areas with a groundwater level > 1.5 m below soil surface. So it is obviously absent in the droughty investigation site F (no proof between the investigation period). How good the natural suitability of this spider is, characterized as a regional indicator species, must be checked up in other extensive studies within the whole population area of this spider. A second indicator system for relatively intact (natural) floodplain conditions is shown in Fig. 6.

Both linyphiid spider species are evaluated as highly (ecological) demanding, preferring biotopes like headstreams, river reeds, and extra wet or often inundated biotopes in the riparian zone of rivers or still waters (Wiehle, 1956; Maurer & Hänggi, 1990). So we can use their presence or abundance to manage the evaluation of special (floodplain typical) biotope qualities to refer to:

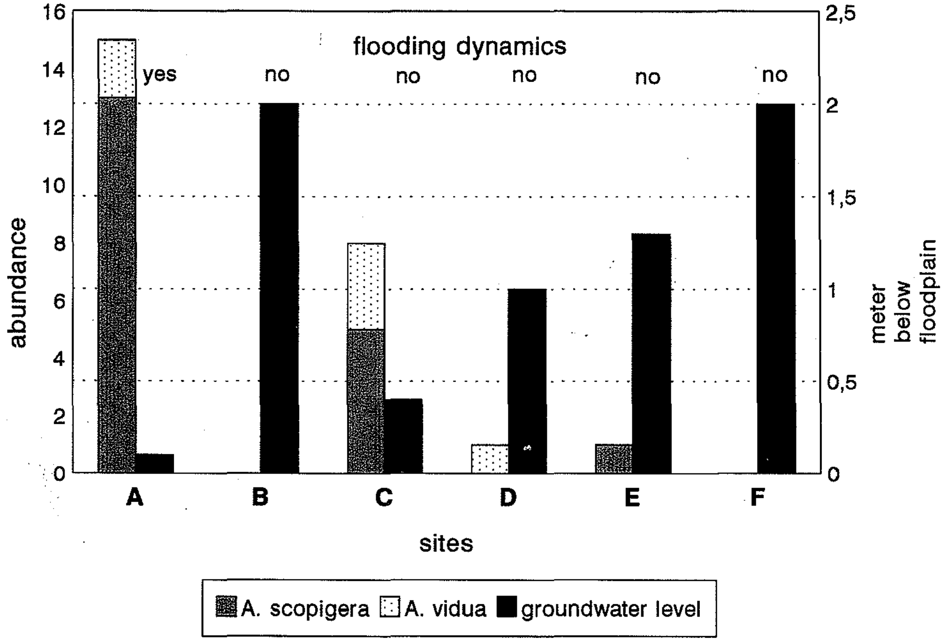


Fig. 6. *Allomengea scopigera* and *Allomengea vidua* (Linyphiidae) as indicator species for natural flooding dynamics and/or surface near groundwater conditions with alternating moisture dynamics.

☐ naturally flooding dynamics in mind of an intact floodplain (site A)
and/or
☐ surface near groundwater conditions with moisture change dynamics (site C).

Obviously naturally, the highest abundance of both hygrophilous species was found in the intact boulder zone of site A. On the other hand the second maximum in site C, without (ecologically effective) flooding dynamics but obviously good moisture conditions for the both ecological demanding species, is more interesting. Here the environmental situation concerning moisture is clearly positively influenced and modified by a weir near the sampling site. The floodplain level of the trap transect region in site C lies a little bit below the water level of the river above the wall of the weir. It can be concluded that the standing water pillar above the weir influences the surrounding area concerning moisture status especially to refer to surface near groundwater conditions. So some more floodplain typical elements in epigeic spider coenosis and often a higher abundance than in immediately neighbouring floodplain stands could be proven.

In summary we can say that starting from well-known partly regionally modified ecological demands of epigeic spider species it is possible to manage the evaluation of "biotope quality" in sense of graduation of vicinity to nature. With the help of multivariate techniques we are today in a position to analyse such complex data matrices as in the present study. So it is possible to gain much more information concerning niche occupancy or niche specialization of selected species and the obviously main factors with formative influences of the discovered coenosis upon the classic ecological situation analysis.

This indicatively and statistically determined information can be used as a technical basis within the framework of ecotope or biotope evaluation as well as for area related planning within the redevelopment measures of the river Ilm and its floodplain. Furthermore, they can serve to cautious prognosis of potential consequences of future projects, conclusion of necessary ecological compensation measures or sucessful control within the framework of biomonitoring.

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