

ASSOCIATIONS OF SPIDER FAMILIES (ARACHNIDA: ARANEAE) OF DIFFERENT HABITATS

by

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SUMMARY. - In 1984 the spider communities of ten different habitats (mesobromion sites, mesobromion sites in succession, forest sites, phragmition) were studied by pitfalls. The sites differ by the composition and the seasonal association of the spider families characterizing the type of biotope as well as its developmental stage. Therefore, the composition of spider families can be used as a first approach for assessing a biotope and its successional stages, but for a more subtle differentiation it is necessary to regard the composition and the ecology of the spider species.

RESUME. - *L'aranéofaune de dix sites de différentes communautés végétales, température et conditions d'éclaircissement ont été échantillonnées pendant une année à l'aide de pièges de Barber. Les sites (mesobromions, mesobromions en succession, forêts, phragmition) diffèrent en ce qui concerne la composition et l'association saisonale des familles d'araignées. Ces dernières caractérisent le type du biotope et aussi son stade de développement. Pour cette raison on peut se servir de la composition des familles d'araignées comme manière préliminaire de juger un biotope et ses altérations, tandis que l'étude des espèces est nécessaire pour une analyse plus profonde et détaillée.*

Index entries : Spider families, composition, seasonal association, differentiation of biotopes.

Mots-clés : *Familles d'araignées, composition, association saisonale, discernement des biotopes.*

INTRODUCTION

In ecology the conception of faunal associations specific for each biotope is undisputed but it is not studied for many animal communities. Studies of annual associations of spider communities suggested by TRETZEL (1955) and THALER (1982) are necessary to establish characteristic spider associations for different habitats. Seasonal associations of spider families as described by THALER et al. (1984) and THALER (1982, 1985) might be the first approach. Under these aspects different habitats in Northern Hesse have been studied.

Associations of spider families of different habitats

STUDY SITES, COLLECTING METHOD, MATERIAL

Study sites

The study sites are located in the Werra-Meißner-district of Northern Hesse at Rohrberg (R1-4), Kindelberg (K1, 2), Graburg (G), Manrod (M1, 2) and in a valley near Hopfelde (P). They are characterized by exposition and inclination, plant communities according to ELLENBERG (1979, 1982), ecological behaviour of plants (ELLENBERG 1979) and by the degree of coverage of the vegetation (Table 1).

Table 1: Exposition, inclination, plant communities, ecological behaviour of plants (mL light figure on average, mT temperature figure on average, mK continentality figure on average, mF moisture figure on average, mR reaction figure on average), coverage of the vegetation (t tree stratum, s shrub stratum, f field stratum) at the study sites.

site	R1	R2	R3	R4	K1
exposition	SSW	SSW	SSW	N	SW
inclination(°)	33	30	19	10	32
plant community	mesobromion	mesobromion in succes- sion to pi- <u>netalium</u>	Melico-Fa- getum	Melico-Fa- getum (Al- lium ursinum facies)	mesobromion
mL	7.58	7.0	5.2	3.4	7.14
mT	5.5	5.0	4.4	5.0	5.4
mK	3.57	3.69	4-24	2.25	3.36
mF	3.85	3.69	5.0	6.75	4.09
mR	7.88	7.5	7.0	7.0	7.13
coverage _t (%)	-	40	100	90	1
coverage _s (%)	1	1	1	-	1
coverage _f (%)	5	90	1	5	5

Table 1 (continuation)

site	K2	G	M1	M2	P
exposition	SW	SE	plateau	plateau	valley
inclination(°)	12	15	2	4	0
plant community	<u>mesobromion</u> in succes- sion to pru- netalium	mesobromion	Querco-Car- pinetum (substitute association of Melico- Fagetum)	Melico-Fa- getum	phragmition
mL	7.33	7.04	3.01	3.61	6.22
mT	5.27	5.36	5.13	5.0	5.0
mK	2.94	3.71	4.07	3.1	3.6
mF	4.08	4.0	5.08	5.0	7.9
mR	7.44	7.2	7.21	7.2	7.1
coverage _t (%)	5	1	80	90	5
coverage _s (%)	15	1	1	-	5
coverage _f (%)	25	55	90	2	50

Collecting method

From March 1984 to December 1984 the spiders were collected by pitfalls. Transparent beakers (8.0 cm high, 7.5 cm in opening diameter, filled up to one third with 3 % formaldehyde) were used as traps. Ten traps were placed in line at one meter distances at each site, except site R2 where the traps were arranged in two 5 trap-lines. They were emptied every two weeks.

Material

At the study sites spiders from 23 families were collected. Determination followed LOCKET & MILLIDGE (1951, 1953) and LOCKET, MILLIDGE & MERRETT (1974), systematics are also according to BRIGNOLI (1983).

RESULTS

Distribution of spider families

The spider families collected are listed in Table 2 with regard to the number and the portion of species belonging to each family and their relative abundance at each study site.

Table 2: List of spider families at the study sites (sn number of species, ps portion of species, d relative abundance of the family).

family	R1			R2			R3		
	sn	ps	d	sn	ps	d	sn	ps	d
Atypidae	-	-	-	-	-	-	-	-	-
Amaurobiidae	-	-	-	-	-	-	1	1.88	0.13
Titanoecidae	1	1.28	0.37	-	-	-	-	-	-
Dictynidae	-	-	-	-	-	-	-	-	-
Dysderidae	1	1.28	0.12	1	1.25	0.68	1	1.88	2.37
Gnaphosidae	9	11.53	9.26	8	10.00	2.70	7	13.20	1.13
Clubionidae	1	1.28	0.12	1	1.25	0.13	2	3.77	0.39
Liocranidae	3	3.84	4.78	4	5.00	2.31	1	1.88	0.13
Ctenidae	1	1.28	1.26	1	1.25	2.88	2	3.77	3.02
Anyphaenidae	-	-	-	-	-	-	-	-	-
Thomisidae	6	7.69	7.66	3	3.75	1.08	-	-	-
Philodromidae	-	-	-	-	-	-	1	1.88	0.13
Salticidae	4	5.12	2.12	3	3.75	0.94	-	-	-
Lycosidae	13	16.66	38.40	6	7.50	35.35	5	9.43	14.10
Pisauridae	-	-	-	-	-	-	1	1.88	0.13
Agelenidae	7	8.97	3.62	4	5.00	10.68	4	7.54	15.38
Hahniidae	2	2.56	0.24	2	2.50	0.67	1	1.88	0.52
Mimetidae	-	-	-	-	-	-	-	-	-
Theridiidae	2	2.56	0.62	4	5.00	2.45	2	3.77	0.26
Tetragnathidae	1	1.28	0.25	-	-	-	-	-	-
Araneidae	1	1.28	0.25	2	2.50	0.26	-	-	-
Erigonidae	12	15.38	10.00	21	26.25	11.69	12	22.64	38.92
Linyphiidae	14	17.94	20.37	20	25.00	27.74	13	24.52	22.65

Associations of spider families of different habitats

Table 2 (continuation)

family	R4			K1			K2		
	sn	ps	d	sn	ps	d	sn	ps	d
Atypidae	-	-	-	-	-	-	-	-	-
Amaurobiidae	2	5.12	0.39	-	-	-	-	-	-
Titanoecidae	-	-	-	1	0.99	0.48	-	-	-
Dictynidae	-	-	-	5	4.95	0.65	-	-	-
Dysderidae	1	2.56	0.66	2	1.98	0.89	2	2.35	0.86
Gnaphosidae	-	-	-	17	16.83	14.26	11	12.94	7.64
Clubionidae	1	2.56	0.13	2	1.98	0.18	2	2.35	0.31
Liocranidae	-	-	-	4	3.96	3.27	4	4.70	2-25
Ctenidae	-	-	-	1	0.99	0.19	1	1.17	0.64
Anyphaenidae	1	2.56	0.13	-	-	-	-	-	-
Thomisidae	-	-	-	9	8.91	6.55	6	7.00	7.75
Philodromidae	-	-	-	-	-	-	1	1.17	0.10
Salticidae	-	-	-	4	3.96	1.91	3	3.52	0.20
Lycosidae	1	2.56	0.13	13	12.87	39.51	10	11.76	46.44
Pisauridae	-	-	-	-	-	-	-	-	-
Agelenidae	5	12.82	66.30	5	4.95	2.44	4	4.70	2.57
Hahniidae	-	-	-	3	2.97	0.67	3	3.52	0.52
Mimetidae	-	-	-	-	-	-	1	1.17	0.10
Theridiidae	1	2.56	0.26	3	2.97	2.51	3	3.52	0.74
Tetragnathidae	-	-	-	1	0.99	0.09	1	1.17	2.27
Araneidae	2	5.12	0.39	2	1.98	0.38	1	1.17	0.10
Erigonidae	10	25.64	20.51	15	14.85	12.33	17	20.00	7.37
Linyphiidae	15	38.46	10.41	14	13.86	12.33	15	17.64	19.49

Table 2 (continuation)

family	G			M1			M2		
	sn	ps	d	sn	ps	d	sn	ps	d
Atypidae	1	1.49	3.81	-	-	-	-	-	-
Amaurobiidae	1	1.49	1.81	2	3.60	0.36	2	4.25	3.46
Titanoecidae	-	-	-	-	-	-	-	-	-
Dictynidae	-	-	-	-	-	-	-	-	-
Dysderidae	1	1.49	0.18	1	1.80	0.96	1	2.12	3.55
Gnaphosidae	7	10.44	4.89	3	5.45	0.28	-	-	-
Clubionidae	1	1.49	0.18	1	1.80	0.22	2	4.25	0.08
Liocranidae	3	4.47	1.08	1	1.80	0.07	-	-	-
Ctenidae	1	1.49	0.72	-	-	-	-	-	-
Anyphaenidae	-	-	-	-	-	-	-	-	-
Thomisidae	6	8.95	4.76	2	3.60	0.88	1	2.12	0.16
Philodromidae	-	-	-	-	-	-	-	-	-
Salticidae	6	8.95	2.89	-	-	-	-	-	-
Lycosidae	9	13.43	34.00	5	9.09	3.17	-	-	-
Pisauridae	-	-	-	-	-	-	-	-	-
Agelenidae	3	4.47	1.99	6	10.90	21.16	5	10.63	30.78
Hahniidae	2	2.98	1.45	2	3.60	0.80	-	-	-
Mimetidae	1	1.49	0.18	-	-	-	-	-	-
Theridiidae	1	1.49	0.18	-	-	-	1	2.12	0.08
Tetragnathidae	1	1.49	0.18	-	-	-	1	2.12	0.08
Araneidae	2	2.98	0.36	1	1.80	0.07	-	-	-
Erigonidae	11	16.41	11.80	13	23.63	23.44	16	34.04	54.26
Linyphiidae	10	14.92	29.61	18	32.72	48.60	18	38.29	7.12

Table 2 (continuation)

family	P		
	sn	ps	d
Atypidae	-	-	-
Amaurobiidae	-	-	-
Titanoecidae	-	-	-
Dictynidae	1	2.08	0.17
Dysderidae	-	-	-
Gnaphosidae	1	2.08	0.17
Clubionidae	1	2.08	0.34
Liocranidae	-	-	-
Ctenidae	-	-	-
Anyphaenidae	-	-	-
Thomisidae	1	2.08	0.17
Philodromidae	-	-	-
Salticidae	-	-	-
Lycosidae	5	10.41	26.00
Pisauridae	-	-	-
Agelenidae	2	4.16	2.38
Hahniidae	1	2.08	1.02
Mimetidae	-	-	-
Theridiidae	1	2.08	1.53
Tetragnathidae	1	2.08	12.07
Araneidae	1	2.08	0.17
Erigonidae	18	37.50	41.48
Linyphiidae	15	31.25	14.45

At all sites only a few families are dominating by the portion of species (fig. 1) as well as by their relative abundance (fig. 2).

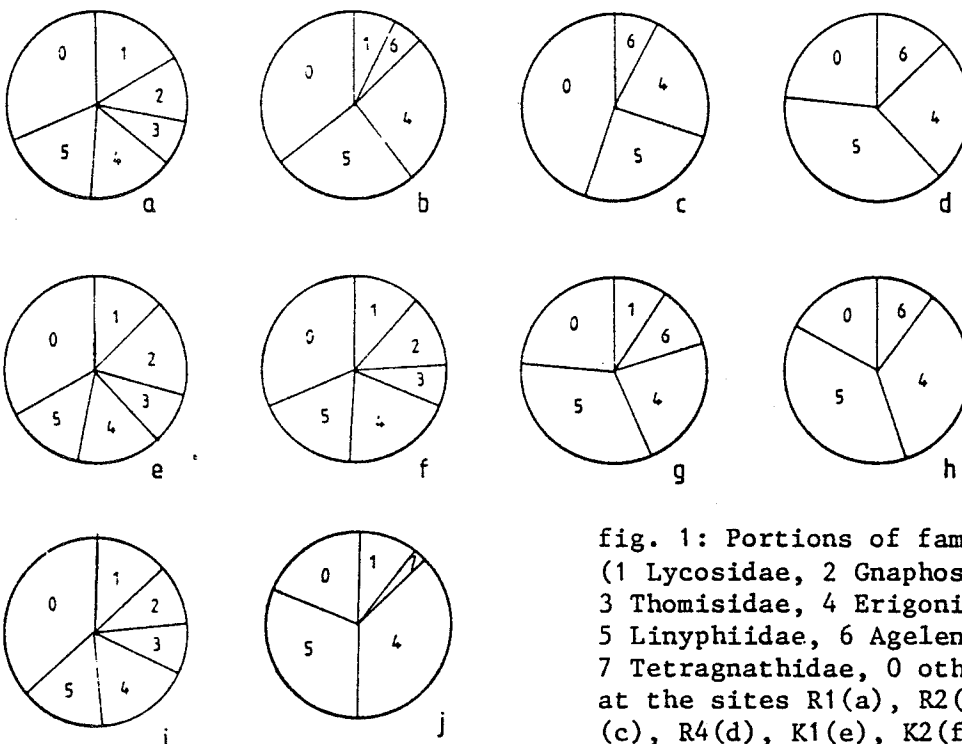


fig. 1: Portions of families (1 Lycosidae, 2 Gnaphosidae, 3 Thomisidae, 4 Erigonidae, 5 Linyphiidae, 6 Agelenidae, 7 Tetragnathidae, 0 others) at the sites R1(a), R2(b), R3 (c), R4(d), K1(e), K2(f), M1(g), M2(f), G(i), P(j).

Associations of spider families of different habitats

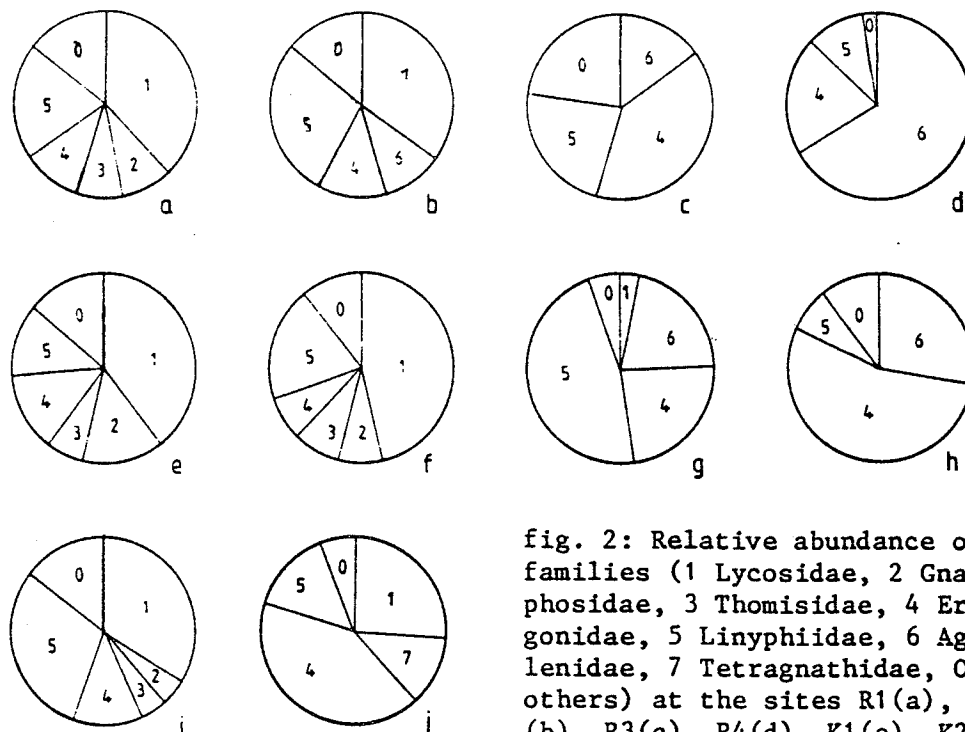


fig. 2: Relative abundance of families (1 Lycosidae, 2 Gnaphosidae, 3 Thomisidae, 4 Eri-gonidae, 5 Linyphiidae, 6 Age-lenidae, 7 Tetragnathidae, 0 others) at the sites R1(a), R2 (b), R3(c), R4(d), K1(e), K2(f), M1(g), M2(h), G(i), P(j).

At the mesobromion sites R1 (fig. 1,2 a), K1 (fig. 1,2 e), G (fig. 1,2 i) and at the mesobromion site in succession to a prunetation K2 (fig. 1,2 f), too, the families Lycosidae, Gnaphosidae and Thomisidae characterize the family composition. The characterizing element of the forest sites R2-4 (fig. 1,2 b-d) and M1,2 (fig. 1,2 g,h) is the family Agelenidae. Beside Agelenids Erigonidae and Linyphiidae are richer in species and more abundant than at the mesobromion sites. At the phragmition (fig. 1,2 j) the families Lycosidae, Erigonidae, Tetragnathidae and Linyphiidae are dominating.

Differences within the biotope categories can be shown by regarding the remaining families. For example, the family Titanoecidae only was found at the sites R1 and K1, the family Atypidae only at site G. Site R2 differs from the other forest sites by the high number and abundance of Lycosidae, Gnaphosidae, Salticidae and Liocranidae occurring mainly at xerothermic sites. Gnaphosidae and Lycosidae also occur at the forest sites R3 and M1 (Table 2).

Seasonal associations of spider families

The patterns of family abundances (fig. 3) reveal the seasonal associations of the spider families and the changes in dominance.

At the mesobromion sites (fig. 3 a,e,i) and the mesobromion site in succession to a prunetation (fig. 3 f) the families Lycosidae, Gnaphosidae and Thomisidae are dominating from spring to the mid of autumn. Erigonidae also are abundant in spring, but mainly in autumn and winter. The main activity period of Linyphiidae is the winter.

In general, the forest sites (fig. 3 b,c,d,g,h) are dominated by Agelenidae in spring and autumn, by Erigonidae in summer and by Linyphiidae in winter. At the forest sites R2 (fig. 3 b), R3 (fig. 3 c) and M1 (fig. 3 g) Lycosidae complete the summer association.

At the phragmition (fig. 3 j) spring and summer are dominated by Lycosidae and Erigonidae, the autumn is dominated by Linyphiidae, the winter by Tetragnathidae, Erigonidae and Linyphiidae.

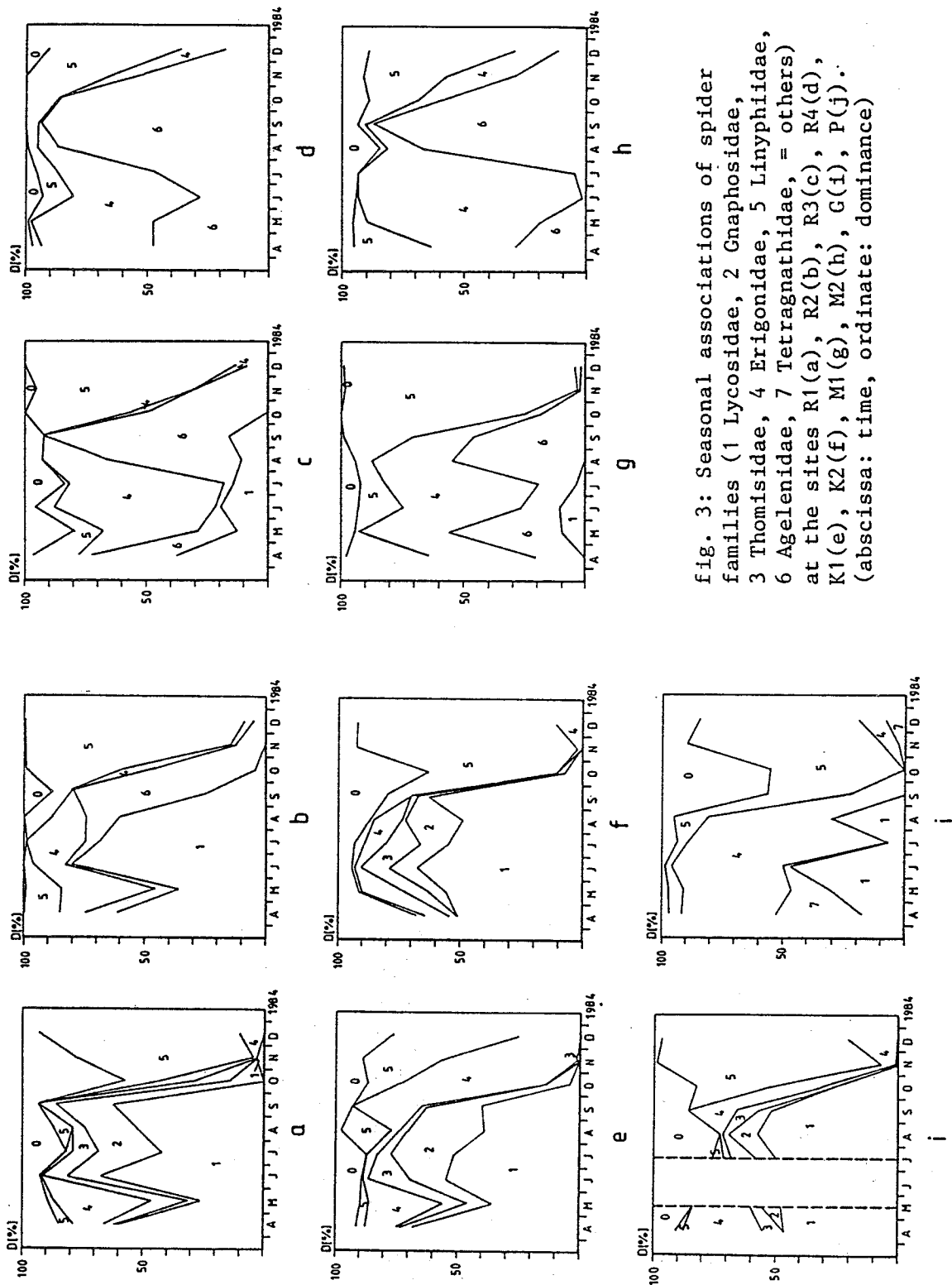


fig. 3: Seasonal associations of spider families (1 Lycosidae, 2 Gnaphosidae, 3 Thomisidae, 4 Erigonidae, 5 Linyphiidae, 6 Agelenidae, 7 Tetragnathidae, = others) at the sites R1(a), R2(b), R3(c), R4(d), K1(e), K2(f), M1(g), M2(h), G(i), P(j). (abscissa: time, ordinate: dominance)

Associations of spider families of different habitats

With regard to the activity of the species with more than 2 % relative abundance (fig. 4) it becomes obvious, that the family patterns are described by only a few species, except the families Gnaphosidae, Thomisidae and Erigonidae at the mesobromion sites (fig. 4 a,e,i) and the mesobromion site in succession to a prunetation (fig. 4 f), the family Erigonidae at the forest site R2 (fig. 4 b), the family Linyphiidae at the forest sites R4 and M2 (fig. 4 d,h) and at the phragmition (fig. 4 j) and the family Lycosidae at the forest site M1 (fig. 4 g).

DISCUSSION

On the basis of the plant communities the study sites can be subdivided into four categories: 1) mesobromion sites, 2) forest sites, 3) sites in succession and 4) phragmition.

Xerothermic association

According to previous results (THALER 1985) the mesobromion sites can be characterized by a xerothermic faunal association dominated by Lycosidae, Gnaphosidae and Thomisidae in summer, Linyphiidae in winter. The families Liocranidae and Salticidae complete this association.

The association is founded on the structural and microclimatic conditions of mesobromion sites. Wandering spiders such as diurnal hunting Lycosidae and Salticidae prefer open space and good lighting conditions. Hiding places are available for the nocturnal Gnaphosidae and the hunting-in-wait Thomisidae. As Titanoecidae only occur at the sites R1 and K1 characterized by very sparse vegetation and warm and dry microclimatic conditions, this family can be used as a differential family. The family Atypidae only occurred at site G. As it digs burrows, it needs a soft, deep soil being available at this site only. Due to the denser vegetation the linyphiid spiders are more abundant at this site, too (HOFMANN in press).

Forest association

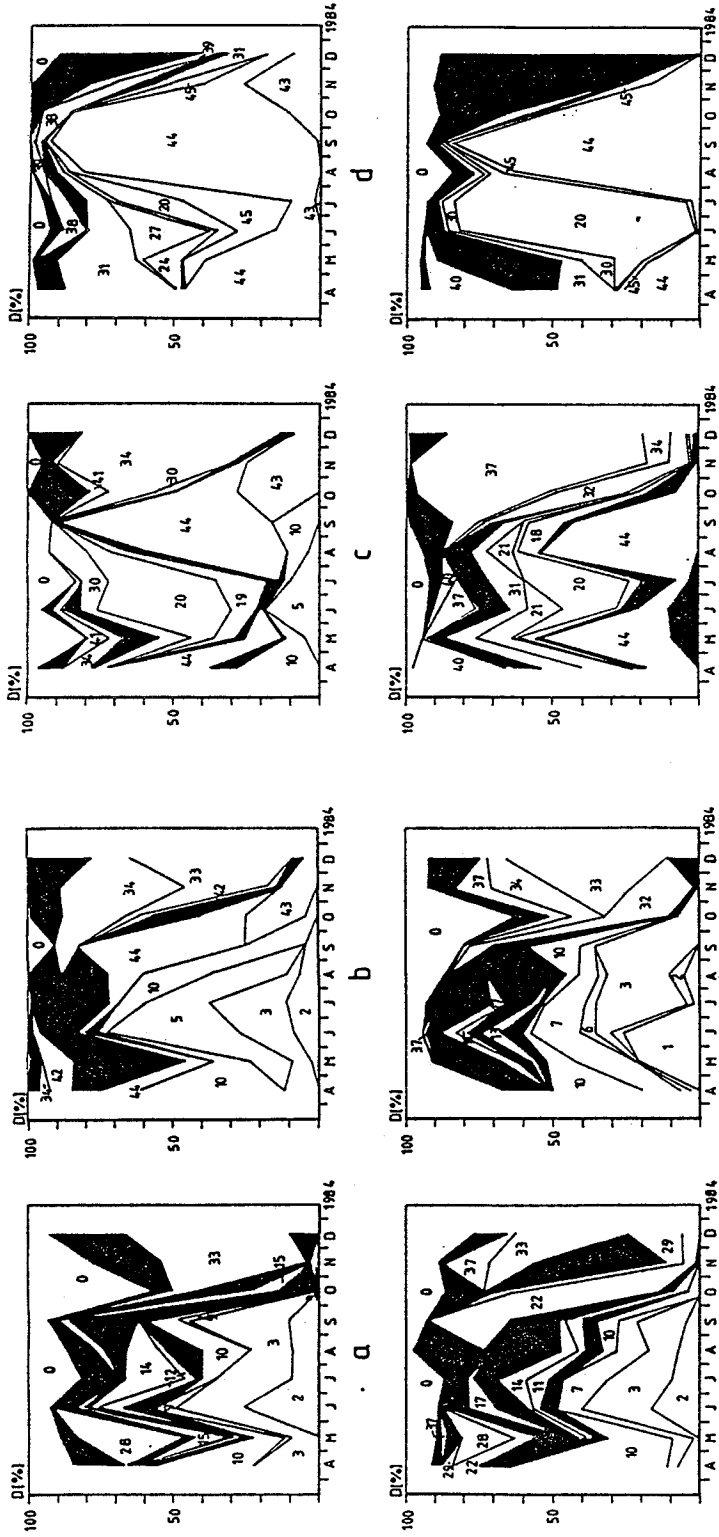
In general, forest sites are characterized by Agelenidae during spring and autumn, by Erigonidae during summer and by Linyphiidae during winter (THALER 1982), but within the categorie "forest" (HOFMANN 1986) there are differences concerning family associations which are mainly caused by structural, but also by microclimatic conditions.

At the Melico-Fagetum sites R4 and M2 the family associations are dominated by Agelenidae and Erigonidae, although their relative abundances differ, possibly caused by the moisture conditions as the only diverging factor. Site R3 characterized as a Melico-Fagetum, too, differs from these sites by the occurrence of Lycosidae, Gnaphosidae and Liocranidae, but they have to be considered as accidental catches originating in neighbouring xerothermic areas. The Querco-Carpinetum M1 is separated from the other forest sites by a dense field stratum mainly build up by *Mercurialis perennis*. This uniform field stratum is settled by only few, but very abundant species of Linyphiidae causing the high dominance of Linyphiidae separating this site from the neighbouring site M2.

Associations of sites in succession

Two of the study sites are sites in succession: site K2 and site R2. Site K2 does not differ from the mesobromion sites by the family association, but it contains different species (fig. 4 f). Site R2 shows a mixture of families belonging partly to the xerothermic association, partly to the

Fig. 4: Activity of the spider species causing the family patterns at the sites R1(a), R2(b), R3(c), R4(d), K1(e), K2(f), M1(g), M2(h), G(i), P(j). (1 *Alopecosa pulverulenta*, 2 *Alopecosa trabalis*, 3 *Aulonia albimana*, 4 *Pardosa amentata*, 5 *Pardosa lugubris*, 6 *Pardosa palustris*, 7 *Pardosa pullata*, 8 *Pirata hygrophilus*, 9 *Tricosa lutetiana*, 10 *Trochosa terricola*, 11 *Drassodes pubescens*, 12 *Haplodrassus signifer*, 13 *Haplodrassus umbratilis*, 14 *Zelotes*



15 *Oxyptila scabricola*, 16 *Oxyptila simplex*, 17 *Xysticus bifasciatus*, 18 *Dicymbium brevisetosum*, 19 *Diplocephalus latifrons*, 20 *Diplocephalus picinus*, 21 *Gonatum isabellinum*, 22 *Gonatum rubens*, 23 *Lophomma punctatum*, 24 *Micrargus herbigradus*, 25 *Oedothorax gibbosus*, 26 *Oedothorax tuberosus*, 27 *Saloca dicerus*, 28 *Tapinocyboides pygmaea*, 29 *Walckenaeria acuminata*, 30 *Walckenaeria corniculans*, 31 *Walckenaeria cuspidata*, 32 *Bolyphantes albiceps*, 33 *Centromerus pabulator*, 34 *Centromerus sylvaticus*, 35 *Helophora insignis*, 36 *Hilaira excisa*, 37 *Leptyphantes menzei*, 38 *Leptyphantes tenebricola*, 39 *Leptyphantes zimmermanni*, 40 *Macrargus rufus*, 41 *Microneta viaria*, 42 *Sintula corniger*, 43 *Coelotes inermis*, 44 *Coelotes terrestris*, 45 *Histopona torpida*, 46 *Pachygnatha clercki*, 0 others; black parts: rest of the family). (abscissa: time, ordinate: dominance)

Associations of spider families of different habitats

forest association. At site K2 transition has started as revealed by the remaining family composition but the changing species composition. This must have been caused by changes of the structural and the microclimatic conditions (HOFMANN in press). At site R2 transition is more advanced and therefore, the developmental direction is already marked by the changing family association.

Bottomland association

The association of spider families described for the phragmition (HOFMANN in press) corresponds by family composition as well as by seasonal associations of families to the association revealed by THALER et al. (1984) for a successional stage of bottomland forest of the Danube, the Pappelau.

CONCLUSION

As shown above, the composition and the seasonal association of spider families differs for the studied types of habitat in a characteristic way. Therefore, the family association can be used as a first approach for establishing characteristic spider associations for different habitats and for assessing biotopes. But it is also becoming obvious, that a subtle differentiation is only possible on the basis of species composition and by regarding the structural conditions of a habitat as well as the conditions of the microclimate.

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