

Consequences of water management on a community of Sarcophagidae (Diptera) in a central European lowland forest

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Abstract. Population structure and dynamics of a lowland forest sarcophagid community in southern Moravia were studied over seven successive seasons to investigate changes in the complex sarcophagid community due to the impact of extensive water management. Drop in the underground water table was reflected in several striking changes, e.g. in quantitative representation of species and diversity of the community. Ecologically sensitive species (bioindicators) decreased in numbers or disappeared totally. During later years some increase in numbers of certain tolerant taxa was observed, thus changing the original character of the community to one approaching, in its composition, that of the neighbour forest stand of originally drier habitats. Irrespective of considerably long-term character of the study no definite prediction appears to be possible of the final phase of the resuccession observed. Compared with these results based on long-term study of a selected model group of insects short-term investigations in taxonomically extensive groups (e.g. orders, families) based on non-specialized sampling methods seem to offer inadequate or problematic results.

This paper forms part of a series devoted to the arthropod communities of the southern Moravian lowland forest region (see e.g. MILLER & OBRTTEL, 1975; OBRTTEL, 1976; VAŠHARA, 1981a,b; VAŠHARA & KNOZ, 1982). No special study has previously been done on the species composition, structure and dynamics of Sarcophagidae in this lowland forest. Although casual data on species of this family inhabiting lowland forest do not offer a suitable base and are generally of little use for synecological interpretation, our previous studies (e.g. POVOLNÝ & ŠUSTEK, 1981a,b, 1982, 1983a,b) showed that Sarcophagidae provide a useful model when intensively studied over a period.

Our investigation of the community of Sarcophagidae in southern Moravia first began in the early seventies (1970, 1973), but systematic and regular sampling was not begun until 1976 and lasted seven years, up to 1984. The main purpose was to discover the effects on the indigenous sarcophagid community of the extensive modifications in recent years of the water management in this region. Alterations of the water regime of the two main streams, viz the rivers Dyje and Morava, had resulted in profound changes, mainly the drainage of a considerable part of the lowland forest, the most

TABLE I

Zoogeographical and ecological classification of Sarcophagidae occurring in the lowland forest near Nejdeč

Species	Zoo- geo- graphy	Vege- tation cover	Humi- dity	Vertical distribution			Trophical relation	Relation to man
				lower	upper	opti- mum		
<i>Sarcophaga Ichmanni</i>	M	F	H	1	4	1	Lumb.	K
<i>Heteronychia</i>								
<i>runderdorffiana</i>	EC	F	H	1	1	1	Mol.	I
<i>Sarcophaga schulzi</i>	WM	E	M	1	8	3.5	Lumb.	K
<i>Heteronychia haemorrhoides</i>	ES	F	M	1	3	1.5	Mol.	I
<i>Heteronychia vagans</i>	TP	E	H	1	8	2	Mol.	T
<i>Bellieria roemleri</i>	WP	F	M	1	8	4.5	Mol.	I
<i>Sarcophaga carnaria</i>	TP	O	M	1	9	2	Lumb.	K
<i>Thyrsocnema incisiobolus</i>	WP	F	M	1	4	2	Copr.	T
<i>Bellieria novae</i>	E	F	M	1	5	2	Mol.	I
<i>Sarcophaga subvicina</i>	WP	O	H	1	9	3.5	Lumb.	K
<i>Heteronychia boettcheriana</i>	M	F	H	1	2	1	Mol.	I
<i>Robinsonella scoparia</i>	H	F	M	1	7	2	Lep.	K
<i>Heteronychia obscurata</i>	TP	F	M	1	4	1	Mol.	I
<i>Parasarcophaga eudeni</i>	PM	F	X	1	3	1.5	Lep.	I
<i>Heteronychia proxima</i>	E	F	X	1	3	2	Mol.	T
<i>Bellieriomima subulata</i>	E	F	M	1	3	1	Mol.	I
<i>Parasarcophaga uratica</i>	TP	F	M	1	4	2	Ins.	K
<i>Parasarcophaga similia</i>	TP	F	M	1	4	2	Lep.	K
<i>Heteronychia nigricaudata</i>	EC	F	M	1	5	4	Mol.	I
<i>Pierettia grandata</i>	E	F	H	1	1	1	Mol.	I
<i>Parasarcophaga albiceps</i>	TP	F	M	1	3	2	Orth.	S
<i>Parasarcophaga portochinskyi</i>	PM	O	X	1	3	1	Ins.	I
<i>Krameria schuetzei</i>	TP	F	M	1	7	4	Lep.	K
<i>Heteronychia haemorrhoides</i>	M	F	H	1	1	1	Mol.	I
<i>Beecher haemorrhoidalis</i>	C	E	M	1	8	1.5	Copr.	S
<i>Pierettia nigricaudata</i>	M	O	X	1	4	1.5	Orth.	K
<i>Parasarcophaga tuberosa</i>	TP	F	X	1	2	1	Lep.	I
<i>Pandellana protuberans</i>	PM	O	X	1	2	1.5	Mol.	I
<i>Bellieria melanura</i>	H	E	X	1	2	1	Copr.	S
<i>Pierettia clathrata</i>	TP	F	H	1	2	1.5	Mol.	I
<i>Raschka striata</i>	TP	O	X	1	2	1.5	Copr.	K
<i>Parasarcophaga hirtipes</i>	H	F	M	1	3	1.5	Lep.	I
<i>Heteronychia nejdekensis</i>	?	?	?	?	?	?	?	?
<i>Pierettia nemoralis</i>	E	F	M	3	8	4.5	Mol.	I
<i>Heteronychia dissimilis</i>	E	F	M	1	3	2	Mol.	I

Explanations:

Zoogeography: C — cosmopolitan, H — holarctic, TP — transpalearctic, WP — westpalearctic, ES — Euro Siberian, E — European, M — mediterranean, WM — westmediterranean, PM — pontomediterranean, EC — Centra-European.

Relation to vegetation cover: F — forest, E — eurytopic, O — open landscape.

Relation to humidity: H — hygrophilous, M — mesophilous, X — xerophilous.

Vertical distribution: 1 — oak veg. tier, 2 — beech-oak veg. tier, 3 — oak-beech veg. tier, 4 — beech veg. tier, 5 — fire-beech veg. tier, 6 — norway spruce-fire-beech veg. tier, 7 — norway spruce veg. tier, 8 — dwarf mountainous pine tier.

Trophical relations: Mol. — parasitoids of Mollusca, Lumb. — parasitoids of Lumbricidae, Lep. — parasitoids of caterpillars, Orth. — parasitoids of Orthoptera, Ins. — parasitoids of various insects, Copr. — coprophagous.

Relations to man: S — synanthropic, K — "Kulturfolger", T — anthropotolerant, I — anthro-pontolerant.

important natural biome of present southern Moravia. Our aim was consequently not only to obtain a picture of species composition, structure and dynamics of sarcophagid communities in the lowland forest but also of any long-term changes. A reason also for this extended study was the fact that comparatively short-term investigations, such as those carried out within the frame of e.g. the IBP and/or MaB programmes, usually covered only over two growing seasons and resulted in the mere registration of taxa. The quantities sampled by routine methods, however, offered limited possibility of their structural and dynamic ecological interpretation, especially when entire insect orders or other extensive insect groups were involved.

The selected locality near the village of Nejdeč is identical with that characterized by VAŠHARA (1981a,b,) and used for similar studies under the IBP and MaB programmes respectively.

MATERIAL AND METHODS

Material was sampled in the locality of Lednice-Horní les near the village of Nejdeč (see VAŠHARA, 1981a,b, and partly also MILLER & OBTEL, 1975, and OBTEL, 1976). The habitat is a natural forest clearing situated at 48°48'22"N and 16°46'32"E at elevation of 161 m a.s.l. on semilegic soils on alluvial deposits of the Dyje river with clayey, the clay making up about 62 %. The pH of the upper layer is neutral to slightly acid, the subsoil is neutral to slightly alkaline. This is one of the warmest and most arid areas of Czechoslovakia, the average annual precipitation being about 320 mm. The average mean air temperature is 9 °C, July being the warmest (19.2 °C) and January the coldest (-1.7 °C) month. Phytocenologically the locality belongs to the *Ulmeto-Fraginetum carpinea*. The forest stand consists essentially of *Quercus robur* (nearly 75 %) and *Fraxinus angustifolia* (24 %). The rest is mainly *Tilia cordata*. The stand is about 100 years old and averages 29 m height. The shrub stratum is dominated by *Cornus sanguinea*, *Fraxinus*, *Ulmus carpiniifolius*, *Tilia cordata*, *Acer campestre*, *Rubus*. The herb stratum is dominated by *Glechoma hederacea*, *Urtica dioica*, *Lysimachia nummularia*, *Circaea lutetiana*, *Deschampsia flexuosa*, in vernal aspect especially by *Picaria verna*, *Gagea lutea*, *Anemone ranunculoides* and *Pulmonaria officinalis*. More detailed characteristics are given by VAŠHARA (1981a,b). For the special purpose of this study Figs. 1—4 and Tab. 2 are included, giving available data on underground water table, mean decade and annual temperatures, mean decade and annual precipitations and mean decade and annual sunshine.

Until 1972 the locality was annually flooded, especially during spring. Following extensive alterations of water management during 1973, the water table dropped gradually, reaching at

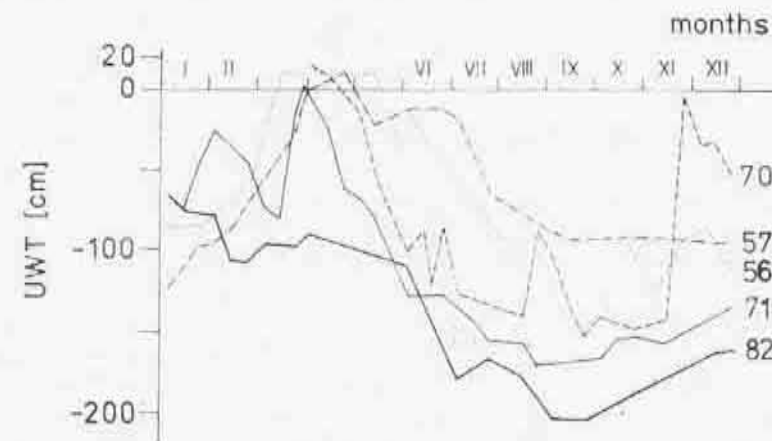


Fig. 1: Monthly development of underground water table (UWT) during the period 1956 to 1982.

present maximum values of about 70–100 cm below the surface in the spring (for details see PRAX, 1978 and Graph 1).

Sarcophagids (represented by about 25–30 species) were sampled in a natural clearing where a male preconnubial aggregation (POVOLNÝ & ŠUSTEK, 1981b) has existed for years. In such aggregations thousands of males may gather to display their preopulatory and copulatory activity, which makes sampling there very effective and representative both for quantity and

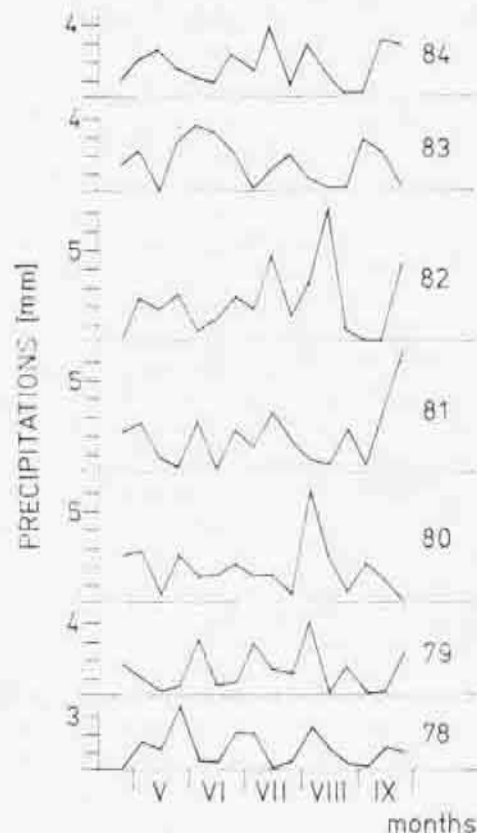


Fig. 2: Mean decade precipitations during the study period (1978–1984).

quality (variety of species). Most males are found at the edges of the clearing on shrubs and herb vegetation exposed southeastward near the adjacent forest road in which especially the males of more stenothermophilous species (e.g. of the genera *Sarcophaga* and *Parasarcophaga*) are active. This sampling habitat occupies about 150 m².

The males were swept individually with a net 0.45 in diameter. Sampling between the end of April and the middle of October comprised at least 15 (1981) and at most 23 (1979) days, averaging 19 days. Since the activity of sarcophagids is limited by clouds netting was only carried out on sunny days between 9.30 a.m. and 3 p.m., when the flies were most active. In view of the considerable male densities in the lowland forest aggregation, netting was continued up to the obvious drop in the individual density of males, which usually occurred after about two hours of netting. Maximum length of sampling was 4 hours. The number of sampling days and the sampling time was adapted to (possibly optimal) weather conditions and to the density of males. The sampling activity decreased after 1980 with the general drop of male densities, when it appeared necessary to allow for a recovery of the numbers of males, as their numbers dropped at

continuously shorter intervals. Samples resulting from netting under decreasing representativeness (unfavourable weather conditions) were excluded. A total of 17,605 males was collected during 1978–1984, the females being ignored for reasons of taxonomic problems and because of their essentially lower densities (the sex ratio being generally less than 1:10). The males were determined specifically by their gonitalia.

The individual species were classified biogeographically (according to their distribution), chorologically (according to their habitat requirements) and trophically (parasitoids of earthworms, snails, caterpillars, grasshoppers, spiders and other insects and arthropods, etc.: Table 1). It is necessary to emphasize that these parasitoid relations appear to be fairly loose, most species being at least temporarily able to develop also various animal carcasses, feces, etc. For the above classifications the papers by ROSENDOUR (1937), SÉGUY (1941), DRABER-MOŠHO (1974) MIHALYI (1979), KATO et al. (1967) etc. as well as our own data were used.

The overlap of the relative qualitative and quantitative representation of the individual species groups was applied for the evaluation of the preferred ecological properties of the individual species due to the selection pressure of abiotic and anthropic factors studied and due to possible interspecific competition. The changes in the representation of the individual species groups were evaluated according to hierarchic diversity (PIELOU, 1975, 1977), making it possible to evaluate the contribution of individual groups of species to the total sample diversity. Especially the shift of the diversity values from the first classification level (considered in the frame of the the individual groups) to the second classification level can be interpreted as a manifestation of community disturbances (ŠUSTEK, 1984) and is verified as a bioindicative criterion in urban Carabid communities. The index of proportional similarity (Kononen's index) was applied as an overlap index, and the Shannon-Wiener formula was used as a diversity index. As indices of alpha diversity the Shannon-Wiener formula and Simpson's index were used (POOLE, 1974; PIELOU, 1975, 1977).

For numerical classification the unweighted average linkage (ORLÓCI, 1978) was used as a sequential polythetic hierarchic method. Two methods were used for the ordination of com-

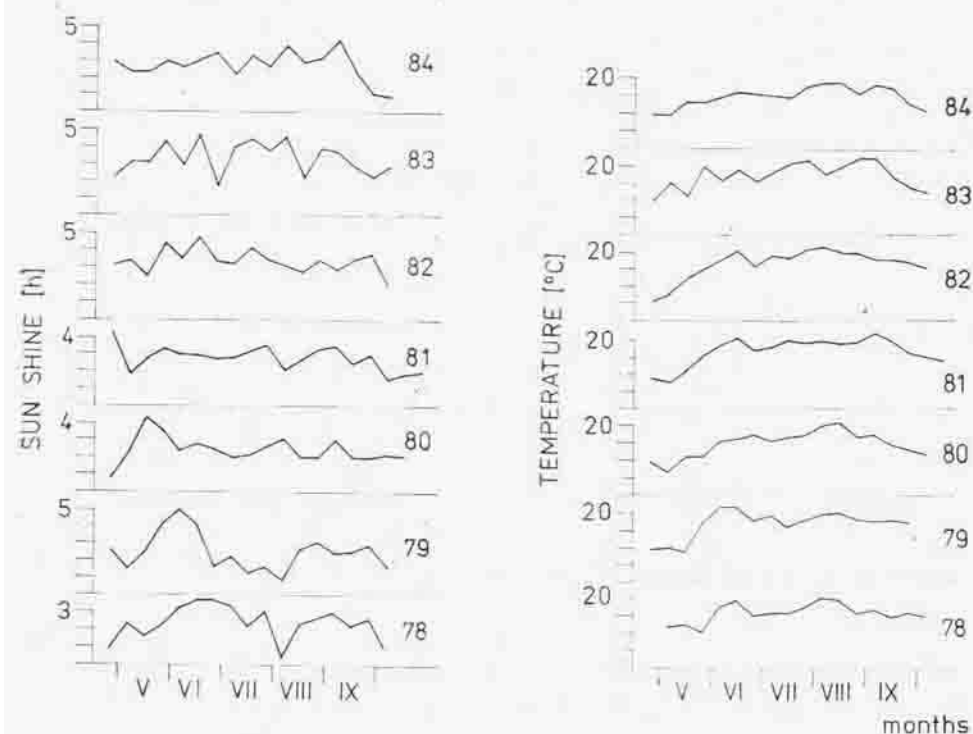


Fig. 3: Mean decade sunshine during the study period (1978–1984). Fig. 4: Mean decade temperatures during the study period (1978–1984).

TABLE 2

Ecological characteristic of sampling sites

Characteristic	Sampling site					
	Nejdek	Bulhary	Klauza	Děvičky	Boleradice	Březina
Longitude	16°46'32"	16°43'00"	16°38'36"	16°39'52"	16°49'58"	16°44'20"
Latitude	48°48'22"	48°49'02"	48°51'55"	48°52'42"	48°58'01"	49°16'51"
Elevation in meters	280	320	410	368	492	161
Vegetation tier	oak	oak	oak	oak	beech-oak	oak-beech
Geological substrate	aluvium	calcareous flysh	limestone scree	calcareous	calcareous flysh	devonic limestone
Trophical group	e	BD	C	D	B	BC
Hydric row	m	n	n	o	n	n
Group of geobiocaeon	QFr-UFrc	CoQ-CaQ	CaAc-AcCa	CoQ	FQ	QFtil
January mean temperature in °C	-1.7	-0.2	-0.4	-1.1	-2.1	-2.8
July mean temperature in °C	19.2	18.9	19.0	18.4	18.4	18.2
Annual mean temperature in °C	9.0	9.1	9.2	8.8	8.6	7.7
Total precipitations in mm	524	518	521	529	539	616
Days with precipitations ≥ 1 mm	90	90	90	90	90	95
Total sunshine in hours	1900	1900	1900	1900	1900	1900
Clear days	55	55	50	50	55	55
Summer days	60	50	50	50	60	55
Winter days	35	35	35	35	45	35
Snow cover in days	40	40	50	50	45	55

Explanations:

Trophical rows: B — normal, C — maple, BC — intermediate, BD — intermediate, D — aleophilous, e — inundated

Hydric rows: m — hygrophilous, n — mesophilous, o — xerophilous

Groups of geobiocaeons: QFr — *Quercus Fraxineta*, UFrc — *Ulmus Fraxineta carpinea*, CoQ — *Cornus Querceta*, CaQ — *Carpinus Querceta*, FQ — *Fagus Querceta*, QFtil — *Quercus Fageta tiliae*

Meteorological data are means 1900—1950

communities, viz polar ordination with recalculation of the oblique axis on the orthogonal axes (ORLÓCI, 1978) due to their suitability for ordination of the sample sets with a high beta diversity; Q-algorithm of PCA analysis was used due to its suitability for ordination of continuously changing samples. Jaccard's index, quantified Jaccard's index and Renkonen's index were used as similarity functions. Jaccard's index in its binary form may be interpreted as an index of abundance similarity. In its quantified form it permits a comparison of changes in the secondary production of the community, and finally Renkonen's index can be interpreted as an index of dominance identity or proportional similarity. The centroid algorithm for factor analysis (TUCKER, 1974) was used for testing the influence of abiotic factors on the stationary characteristics of community structure. Species dominance and species frequency is understood here in the sense of BALOGH (1958) and SCHWERTFEGGER (1975).

We distinguished individual seasonal aspects (viz vernal, aestival, serotinal and autumnal) to evaluate the possible dynamic changes of this community with respect to the individual seasonal phases of climate and their synergism with possible anthropic changes (see Tabs. 4—7). The characteristics of these individual aspects are the subject of a separate paper (POVOLNÝ & ŠUSTEK, in press). For the necessary comparative material of the close sarcophagid communities

in the lower vegetation tiers and their local modifications (Bulhary, Pálava-Klauza and Pálava Děvičky, first vegetation tier; Boleradice, second vegetation tier; and Březina, third to fourth vegetation tier) were used, each of them being statistically (both quantitatively and qualitatively) representative and significant (see Tab. 2).

RESULTS AND DISCUSSION

(1) Position of the sarcophagid community (see Tab. 3) of the lowland forest (as extrazonal formation) compared with sarcophagid communities of the 1st—3rd vegetation tier

As indicated by the cluster analysis of the communities studied (Fig. 5) the lowland forest community shows a comparatively isolated position in relation to the nearest communities (cf. Bulhary, Pálava, Boleradice and Březina). Concerning the species composition of the lowland forest, the Lednice community appears to be comparatively close to those of Pálava-Klauza and Boleradice. The community similarity is mainly due to the dominance of identical species, such as *Sarcophaga lehmanni* and the three other *Sarcophaga* spp. (*S. schulzi*, *S. subvicina*, *S. carnaria*) and to the constant representation of such species as *Thyrsocnema incisilobata*, *Robineauella scoparia*, *Bellieria noverca*, *Bellieriomima subulata*, *Parasarcophaga emdeni*, etc.

A notable difference seems to exist between the Lednice community and those of Pálava-Děvičky and Bulhary. This difference is evident by the low representation of *Sarcophaga lehmanni* and the presence of such discrimination taxa of the Děvičky xerothermophilous forest steppe as *Disachneta arcipes*, *Heteronychia filia*, as well as by the clear dominance of *S. carnaria* and, partly, *S. schulzi* and *S. subvicina*, irrespective of several other less apparent but important specific differences (*Pierretia nigriventris*, etc.). As for the Bulhary community, its present state shows an originally rather representative forest stand of the 1st vegetation tier in the process of degradation due to the overpopulation of red deer and other game animals. This is reflected in the decrease of typical forest taxa and in the increase in such coprophagous or even synanthropic species as *Thyrsocnema incisilobata*, *Parasarcophaga albiceps*, *P. barbata*, *Ravinia striata*, etc., as successful competitors of natural forest forms. The community of Březina shows a quasi-intermediary position between the (undisturbed) referent communities of the 1st and 2nd vegetation tiers (Pálava and Boleradice), representing a well preserved community of the 3rd (to 4th) vegetation tier (essentially *Fagetum*) and characterized by a high abundance of such species as *Bellieria rosellei*, *Heteronychia obscurata*, etc. irrespective of the presence of such very specific discrimination taxa as *Pierretia lunigera* and *P. discifera* (see POVOLNÝ & ŠUSTEK, 1983b).

As for secondary production (Fig. 5), the Lednice community shows one cluster (at 32 % level) with the communities of Pálava-Klauza, Bulhary and Boleradice, obviously due to a similar representation of such species as *Sarcophaga lehmanni*, *S. carnaria*, *S. subvicina*, *S. schulzi*, further *Thyrsocnema incisilobata*, *Robineauella scoparia*, *Bellieria noverca*, *Bellieriomima subulata*, *Parasarcophaga emdeni* and other essentially woodland species.

Concerning the dominance identity (Figs. 5, 6), the Lednice community itself shows a considerably enclosed fusion at a level of 58 % (irrespective of individual years) due to the abundance of such lowland forest specific taxa as the abundant and comparatively constant *Sarcophaga lehmanni*, *Hetero-*

TABLE 3

Dominance and frequency of Sarcophagidae in the lowland forest near Nejdok during the years 1978–1984

Species	1978		1979		1980		1981		1982		1983		1984	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F
<i>S. lehmanni</i>	31.32	47.05	30.03	62.04	24.35	35.77	16.59	16.46	27.68	23.71	27.45	28.93	31.05	34.61
<i>H. rohdendorfi</i>														
<i>fiava</i>	16.56	25.20	17.42	30.00	13.49	19.81	13.97	13.86	9.94	8.52	9.61	10.13	12.19	13.33
<i>S. schulzi</i>	10.71	16.29	9.44	16.26	13.24	19.45	13.91	13.79	12.34	10.57	10.49	10.06	7.01	7.66
<i>H. haemorrhoides</i>	6.24	9.50	7.22	12.43	2.81	4.13	5.98	5.93	1.50	1.28	4.87	5.13	1.52	1.66
<i>H. vagans</i>	5.03	7.70	5.93	10.21	4.79	7.04	7.05	7.00	5.16	4.42	5.24	5.53	4.82	5.27
<i>B. russelli</i>	3.02	4.60	3.15	5.43	7.11	10.45	1.94	1.93	4.72	4.04	4.49	4.73	2.48	2.72
<i>S. carnaria</i>	3.05	4.65	2.67	4.00	6.00	8.81	5.64	5.60	6.39	5.47	3.16	3.33	1.62	1.77
<i>T. incisulobata</i>	3.42	5.20	2.44	4.21	3.40	5.00	2.75	2.73	4.50	3.85	2.02	2.13	2.64	2.88
<i>B. noverca</i>	2.53	3.85	2.22	3.82	4.61	6.77	4.43	4.39	5.39	4.61	6.51	6.86	2.48	2.72
<i>H. subcicuta</i>	2.73	4.15	2.39	4.13	3.80	5.59	1.74	1.73	2.05	1.76	1.01	1.06	1.37	1.50
<i>H. boettcheriana</i>	0.49	0.75	1.96	3.39	6.31	9.27	12.16	12.06	8.06	6.90	5.81	6.13	1.37	1.50
<i>R. scoparia</i>	4.56	6.95	1.56	2.62	1.23	1.81	2.62	2.60	2.77	2.38	2.40	2.53	2.69	2.94
<i>H. obscurata</i>	1.61	2.45	1.96	3.39	3.55	5.22	6.38	6.33	3.90	3.42	7.71	8.13	18.64	20.38
<i>P. emdeni</i>	2.66	4.05	1.61	2.78	0.77	1.13	0.33	0.33	0.83	0.71	1.39	1.46	2.74	3.00
<i>H. proxima</i>	1.45	2.20	1.61	2.78	0.49	0.59	1.27	1.26	0.94	0.80	1.89	2.00	1.93	2.11
<i>B. subulata</i>	0.75	1.15	0.75	1.39	1.76	2.59	1.68	1.66	1.84	1.57	1.96	2.06	1.52	1.66
<i>P. aratrix</i>	1.22	1.85	0.63	1.08	0.86	1.27	0.26	0.26	0.16	0.14	0.12	0.13	0.30	0.33
<i>P. sinilis</i>	1.64	2.50			0.24	0.36	0.40	0.39	0.55	0.47	1.39	1.46	1.37	1.50
<i>H. nigricaudata</i>			0.27	0.47	0.55	0.81	0.13	0.13	0.16	0.14	1.51	1.59	0.15	0.16
<i>P. granulata</i>	0.07	0.09	0.35	0.60	0.21	0.31	0.13	0.13	0.05	0.04				
<i>P. albiceps</i>	0.26	0.39	0.07	0.13	0.27	0.40	0.20	0.19	0.16	0.14	0.31	0.33		
<i>P. portschinskyi</i>	0.29	0.45	0.07	0.13	0.09	0.13			0.38	0.33	0.31	0.33	0.91	1.00
<i>K. schuetzei</i>	0.07	0.09			0.06	0.09	0.13	0.13						
<i>H. haemorrhoides</i>							0.13	0.13	0.11	0.09			0.05	0.05
<i>B. haemorrhoidalis</i>	0.16	0.25	0.05	0.08					0.05	0.04				
<i>P. nigricaudata</i>	0.07	0.09	0.02	0.04					0.05	0.04				
<i>P. tuberosa</i>	0.07	0.09	0.02	0.04										
<i>P. protuberans</i>											0.06	0.06		
<i>B. melanura</i>	0.03	0.04									0.06	0.06		
<i>P. clathrata</i>			0.02	0.04			0.06	0.06					0.05	0.05
<i>R. striata</i>			0.02	0.04					0.05	0.04				
<i>P. harpax</i>									0.05	0.04			0.15	0.16
<i>H. nejdensis</i>											0.06	0.06		
<i>P. nemoralis</i>											0.06	0.06		
<i>H. dissimilis</i>													0.25	0.27
Samples														
number	20		23		22		15		21		15		18	
Individuals														
total	3043		3960		3232		1488		1793		1581		1968	
Individuals														
per sample	152.15		172.17		146.91		99.20		85.98		105.40		109.83	
Species total	25		25		23		24		27		25		24	
Alpha														
diversity H	3.40		3.18		3.57		3.62		3.58		3.64		3.31	

Explanations: D – dominance, F – frequency.

nychia rohdendorfi and *H. vagans*, as well as to the presence of such discrimination taxa as *Pierretia granulata* and *P. clathrata*.

(2) Manifestations and changes in population dynamics (Tab. 3, Fig. 7) of the dominant and most frequent taxa

The following are the most characteristic manifestations and changes observed:

1. The trend towards disappearance (extinction) or extreme rarity of such stenotopic discrimination taxa as *Pierretia granulata* (Fig. 7, Tab. 3) this species being absent for years from the community studied; further *Pierretia clathrata*, *Heteronychia haemorrhoides*, *Parasarcophaga tuberosa*, representing either generally endangered species or species reaching, near Lednice, their northwestern distribution limit. For other rare species of this category see Tab. 3.

2. A considerable or even strong decrease in numbers of such species as *Heteronychia rohdendorfi* and *H. haemorrhoides*.

3. Less apparent or very slight but still important decrease in numbers of such species as *Heteronychia vagans* and *Bellieria rosellei*, both of which are woodland species with comparatively high hypsometrical tolerance.

4. A sudden and comparatively strong decrease and a later slow increase in numbers of such species as *Sarcophaga lehmanni* and *Parasarcophaga emdeni*.

5. A distinct increase in such characteristic species, associated with mesophilous oak stands, as *Heteronychia obscurata*, *H. boettcheriana* and partly also *Bellieria noverca* and *Bellieriomima subulata*.

6. A striking increase in such species associated with cultivated central European steppe (agrobiocenoids), as *Sarcophaga schulzi* and *S. carnaria* at the begin of the eighties, and the slow return of these forms to their earlier density during the last two years of investigation. For all these six points see Tab. 3 and Fig. 7.

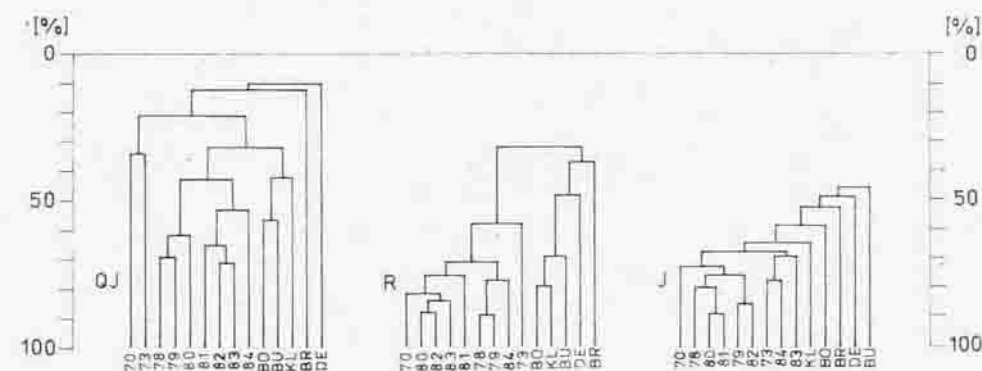


Fig. 5: Classification of the community studied during the successive years (1978–1984) and of the reference communities according to abundance affinity (QJ), dominance identity (R) and species similarity (J). BO-Boleradice, BU-Bulhary, KI-Pálava-Klauza, DE-Pálava-Devičky, BR-Březina.

In these population dynamic trends obvious differences exist between the aestival and serotinal aspects. In the species associated with agrobiocenoids a significant synergism exists between anthropic changes in the lowland forest and the climatic manifestations of the serotinal aspect (Table 6, Fig. 7). This synergism is reflected by a distinct increase in these species at the middle of the investigation period (early eighties) during which the lowland forest was obviously exposed to decisive ecological stress. The same feature of population dynamics is reflected in a striking decrease in *Sarcophaga lehmanni* during the serotinal aspects of 1979–1981 which was one of the most marked manifestations of the profound changes in the community studied. Contrary to this, *S. lehmanni* appeared to be more resistant during the aestival aspect of these seasons. The next striking phenomenon was a decrease in the habitat specific taxon *Heteronychia rohdendorfi* during the aestival aspect (Tab. 5, Fig. 7) from which this species does not seem to have recovered wholly. The distinct manifestation of the changes observed during the serotinal aspect (Tab. 6, Fig. 7) can be put in relation with a striking shift of temperature peaks to the late summer months during 1980–1984. On the other hand, the comparatively cold spring weather of these particular seasons is positively reflected in the composition of the vernal aspects. For the above interpretations compare Tables 3–7 and Fig. 7.

The above changes in population fluctuations are clearly reflected in the hierarchic classification of aspects of this community during the individual seasons (Fig. 8), in which the aestival and the serotinal aspects respectively of the early, middle and late period of sampling tend to form individual clusters at higher levels of similarity.

This is reflected in the dendrogram of species similarity (Fig. 8) by the agglutination of the aestival and the serotinal aspects of the year 1981 (A81–S81), further by clustering the aestival and serotinal aspects of the year 1978 (A78–S78), by clustering the aestival and the serotinal aspects

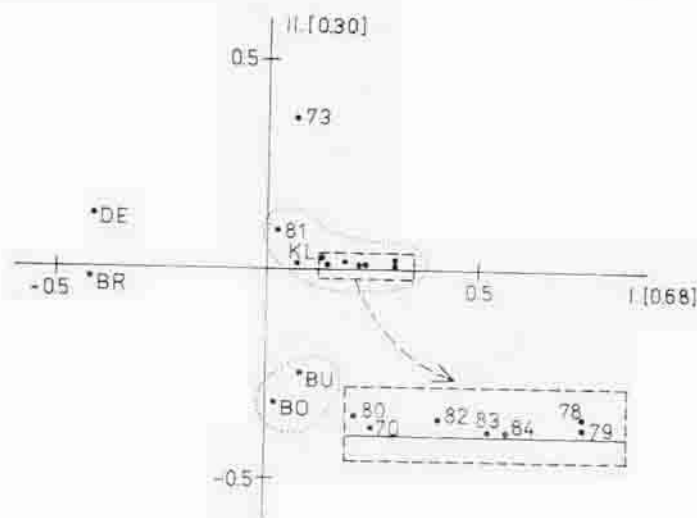


Fig. 6: PCAD ordination of the community studied during the successive years 1970–1984 and of the reference communities according to dominance identity. Abbreviations as in Fig. 5.

of the years 1979–1982 (A79–S82) (Fig. 8), and by their fusion with the above cluster (A78–S78) at a lower similarity level. Finally this is also reflected in the fusion of the aestival and the serotinal aspects of the years 1982–1983 (A82–S83).

In the dendrogram of dominance identity (Fig. 8) the phenomenon is reflected in the clustering of aestival aspects of the years 1980–1983 (A80 to A83), further on in the clustering of the vernal and the serotinal aspects of the year 1978 (V78–S78). The next clusters are formed by the aestival aspect of 1979 and the serotinal aspect of 1982 (A79–S78), as well as by the serotinal aspects of the years 1980–1982 (S80–S82) respectively.

Another clear manifestation of this phenomenon is seen in the polar ordination (Figs. 9–11) after the individual criteria, in which a clear differentiation of the individual aspects is distinct as well as striking polarity of the individual aspects in the years 1978, 1983 and 1984 respectively, wherein the aspects of the years 1980–1982 show a central position between the two poles (Figs. 9–11).

At lower levels there is an apparent tendency for the separation of the aestival and serotinal aspects in the fusion of such clusters (Fig. 8). In the fusions of such clusters the aestival and serotinal aspects tend to become separated at lower levels as well as differentiated from the aestival and autumnal aspects respectively.

(3) Changes in the proportion of individual synecological groups

1. According to hydricity (Figs. 12, 13)

Since the very beginning of the intensive study period (1978) a striking decrease has been apparent in the dominance of hygrophilous taxa (Fig. 12). Their representation dropped to minimum values during 1983, a slight increase was indicated during 1984, coinciding with the pluvial character of that summer, including its generally low air temperatures. It seems, consequently, that local climate factors can moderate, at least in the short term, the negative consequences of the draining of the lowland forest. The group dominance of mesophilous taxa shows, on the contrary, a considerable increase culminating during 1983 and decreasing again during 1984. The representation of xerophilous taxa decreased after 1978 up to 1980–1981 and started to increase slowly during the last two years.

The above changes are clearly reflected in the hierarchic diversity (Fig. 13) related to the humidity factors, the diversity having a similar trend as the above group dominance within the frame of the individual groups. Contrary to this common trend, the diversity of the hygrophilous taxa decreased progressively without any indication of recovery during the pluvial season of 1984. The diversity on the second classification level increased distinctly, at the same time indicating the impoverishment of the individual synecological groups and the progressive degradative changes in the community.

2. According to vegetation cover (Figs. 14, 15)

Relating to the vegetation cover of the habitat, a striking decrease in the group dominance (Fig. 14) of woodland taxa is obvious during 1978–1981. From 1981 to 1984 the group dominance of these taxa increased, exceeding

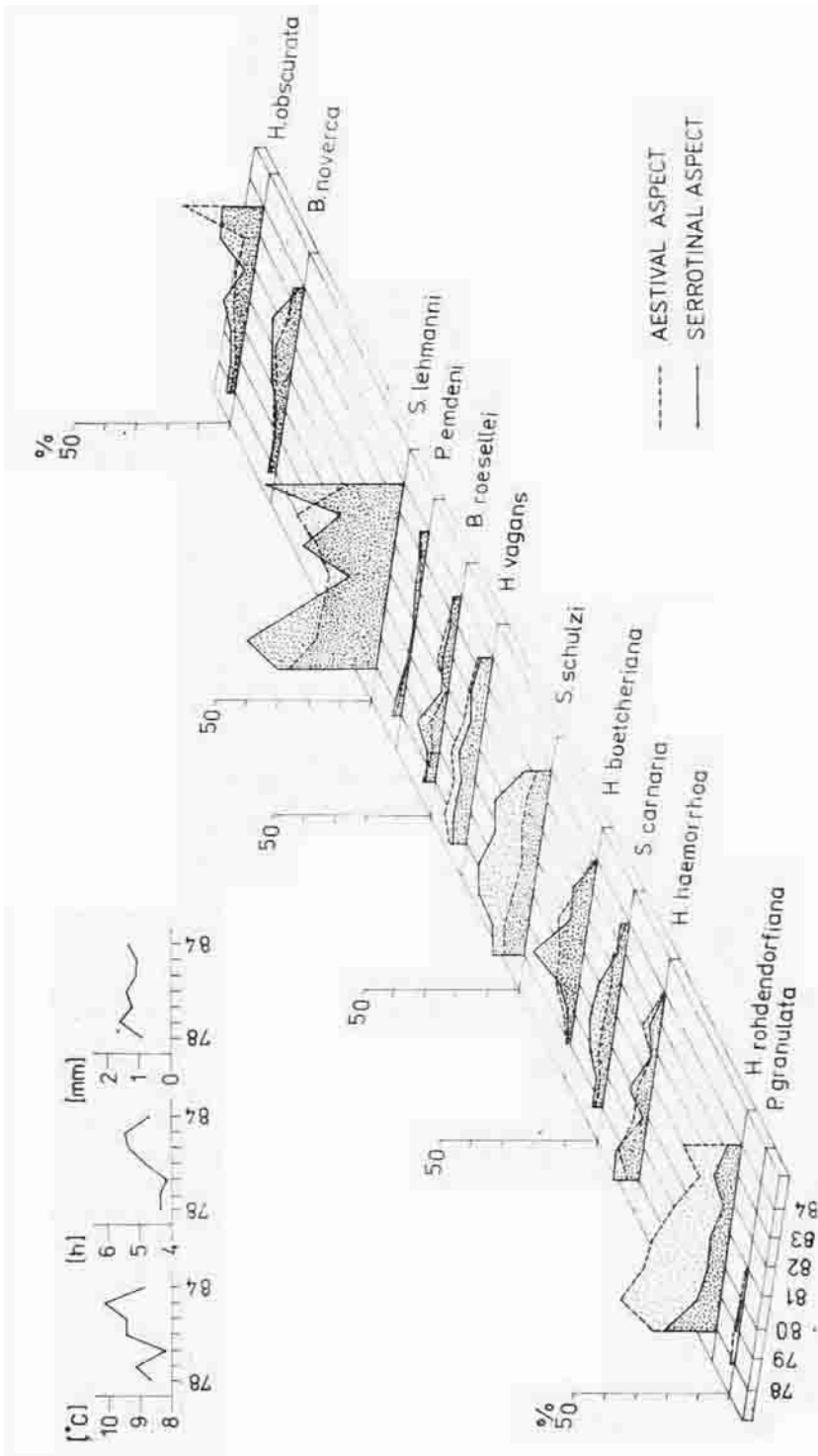


Fig. 7: Changes of dominance in most indicative species during aestival and serotinal aspects, and annual mean temperatures, sunshine and precipitation during the study period 1978—1984.

the values that occurred not only during 1978—1979 but also during the individual (but representative) samples of 1970 and 1973 (when the underground water table was still nearly normal). On the contrary, the representation of the eurytopic open landscape (culturophilous) taxa increased after 1979, culminating in 1981 and decreasing afterwards up to 1984 (Fig. 14).

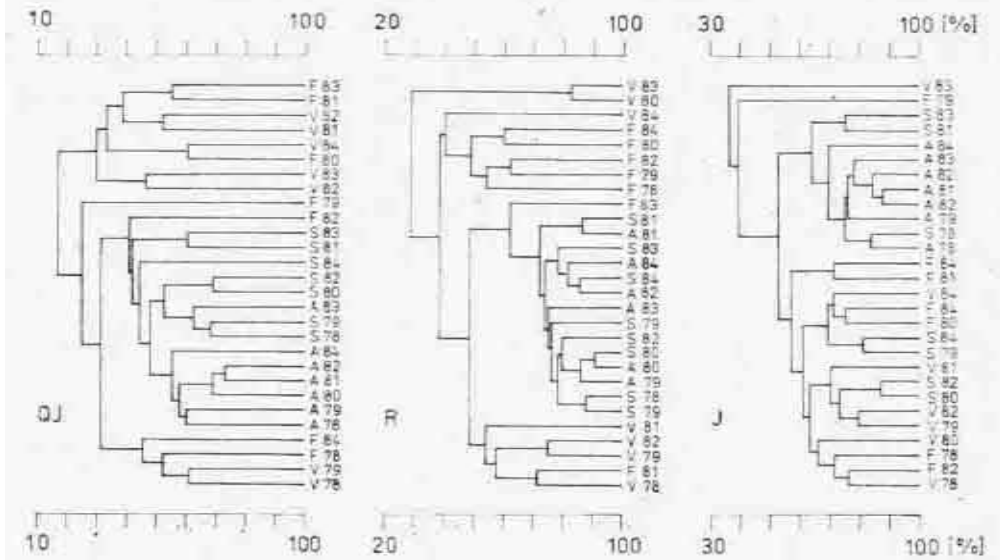


Fig. 8: Classification of individual aspects of the community studied during 1978—1984 according to abundance affinity (QJ), dominance identity (R) and species similarity (J). Aspects: V-vernal, A-aestival, S-serotinal, F-autumnal (fall).

Concerning the hierarchic diversity (Fig. 15) of the synecological groups related to the vegetation cover, an increasing trend in the diversity of woodland species was manifested during the entire study period, culminating locally in 1984. In eurytopic and culturophilous (open landscape) taxa only a slight increase in diversity was observed during 1980—1981. Generally, the trend in changes of their diversity remained rather balanced. Concerning the second classification level (whereby the alpha diversity remained almost unchanged — see Fig. 15) demonstrates that a succession followed within the community studied in the course of which forms characteristic of mesophilous forest formations started to play an important role (see e.g. *Heteronychia obscurata* in Figs. 7, 14, 15). Species having other relation to the vegetation cover of the habitat did not participate in this process of changes so that the community kept its woodland character during the last phase of our observation. The question remains open how long this trend will continue in the future.

3. According to host groups (Figs. 16, 17)

During the study period a striking culmination in the group dominance of malacophagous sarcophagids (Fig. 16) was observed in 1981 and again during 1983 showing a slight maximum. A striking negative relation to this trend is seen in the group dominance of lumbricophagous species, which decreased during 1979—1981. During 1981, as the malacophagous taxa

TABLE 4

Dominance and frequency of Sarcophagidae in vernal aspect in the lowland forest near Nejdek

Species	1978		1979		1980		1981		1982		1983		1984	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F
<i>S. lehmanni</i>	37.12	24.50	36.70	22.00	32.60	7.50	31.14	9.50	40.35	11.50	20.68	6.00	50.00	8.00
<i>H. rohulendor- fiana</i>	31.81	21.00	5.00	3.00			22.95	7.00	1.75	0.50				
<i>S. schulzi</i>			20.83	12.50	26.08	6.00	16.39	5.00	17.54	5.00	5.17	1.50	12.50	2.00
<i>H. haemorrhoida</i>	2.27	1.50					1.63	0.50						
<i>H. vagans</i>	2.27	1.50	1.66	1.00			6.55	2.00	5.26	1.50			12.50	2.00
<i>G. roesellei</i>	4.54	3.00	14.16	8.50	10.86	2.50	9.83	3.00	8.77	2.50	24.13	7.00	3.12	0.50
<i>S. carnaria</i>	11.36	7.50	8.33	5.00	6.52	1.50			3.50	1.00	3.44	1.00		
<i>T. incisilobata</i>	0.75	0.50	5.00	3.00			6.55	2.00	15.78	4.50				
<i>B. noverca</i>	4.54	3.00	5.83	3.50	23.91	5.50			3.50	1.00				
<i>S. subvicina</i>	1.51	1.00	0.83	0.50			1.63	0.50	1.75	0.50			3.12	0.50
<i>H. boettcheriana</i>							1.63	0.50						
<i>R. scoparia</i>	2.27	1.50											9.37	1.50
<i>H. obscurata</i>											1.72	0.50	6.25	1.00
<i>P. emdeni</i>	1.51	1.00	0.83	0.50										
<i>H. proxima</i>									1.75	0.50				
<i>B. subulata</i>							1.63	0.50						
<i>P. atratrix</i>			0.83	0.50										
<i>P. similis</i>													3.12	0.50
Sample number	2		2		2		2		2		2		2	
Individuals														
total	132		120		46		61		57		58		32	
Individuals per														
sample	66		60		23		30.5		28.5		29		16	
Species total	11		11		5		10		10		5		8	
Alpha														
diversity H'	2.42		2.64		2.13		2.67		2.57		1.97		2.89	

Explanations: D — dominance, F — frequency.

showed a striking local minimum (Fig. 16), the lumbricophagous species showed a distinct culmination in group dominance. After 1982 the group dominance of lumbricophagous taxa decreased slightly up to 1984. Within the remaining groups of Sarcophagidae the group dominance of species remained rather constant, only during 1982 the maximum values were reached locally in species parasitizing orthopterous and other insect groups (Fig. 16). In species parasitizing lepidopterous larvae the group dominance decreased during 1978—1979 and reached minimum values in 1980, after which it started to increase again, almost reaching levels of 1978. The curve representing the group dominance of sarcophagids parasitizing insects in general shows a course similar to that of species parasitizing lepidopterous larvae.

The hierarchic diversity (Fig. 17) at the first classification level shows, irrespective of oscillations during successive years, an increasing trend in malacophagous taxa and a decreasing one in lumbricophagous species round the middle of the study period. The curve representing considerably low diversity values in entomophagous taxa decreased during 1978—1983 down to minimum values during 1980—1981, after which it increased again up

to 1984. The diversity of the different host groups at the second classification level decreased during 1978—1981 and increased slightly afterwards, regardless of considerable oscillations (Fig. 17).

In spite of the generally little known relations of parasitoid Sarcophagidae to their hosts and in view of the obviously limited specificity of their para-

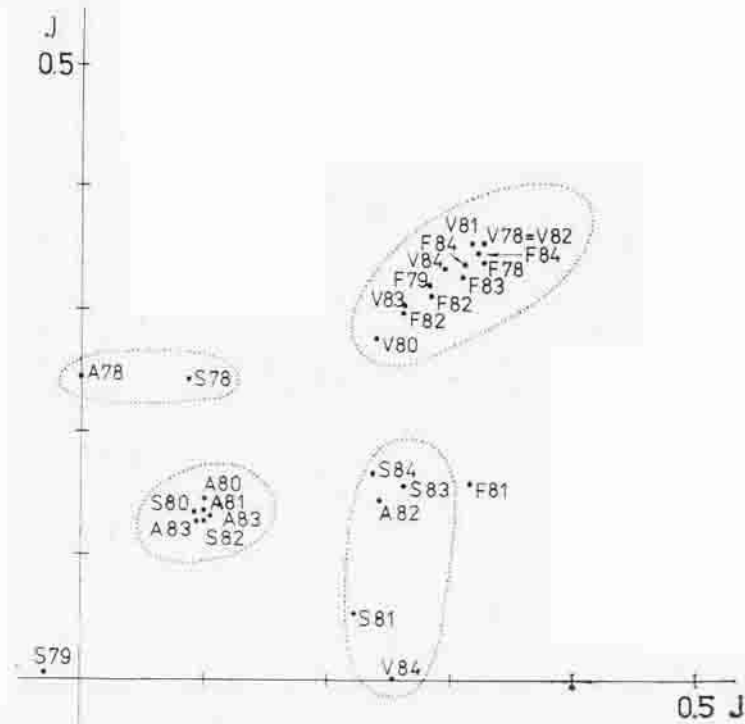


Fig. 9: Polar ordination of the individual aspects of the community studied during 1978—1984 according to species similarity. Abbreviations as in Fig. 5 and Fig. 8 respectively.

sitism, the increasing importance of insects as hosts of sarcophagid larvae appears to have played an important role in the community studied. A special study of this little known part of sarcophagid ecology, with special regard to competition, would be necessary to elucidate this problem.

4. According to reactions on anthropic interference (Figs. 18,19).

Between 1978—1981 a considerable decrease was observed in the group dominance of culturophilous taxa (Fig. 18). During 1982 dominance of this group showed a local minimum almost equalling the initial values of 1978—1979 and it dropped slightly during 1983—1984. The group dominance of anthropointolerant species shows a distinctly negative relation to that of culturophilous taxa, as it increased between 1978—1981. After a striking local minimum during 1982 the group dominance of the anthropointolerant species increased again during 1983—1984 (Fig. 18). The group dominance of

anthropotolerant (culturophilous) species and of synanthropic ones appears to be rather balanced during the entire study period. The development of group dominance of anthropointolerant taxa shows a clear relation to that of the group dominance of mesohygrophilous woodland taxa, as is clearly seen especially in *Heteronychia obscurata* and partly also in *H. boettcheriana* (Fig. 18).

As for the hierarchic diversity of Sarcophagidae according to their relation to humidity (Fig. 19), a clear increase in the diversity of anthropointolerant taxa is evident at the first classification level (disregarding certain oscillations of this index) which culminated during 1983 and dropped distinctly during 1984. In view of the fact that anthropointolerant taxa comprise mostly woodland species, this decrease is obviously due to the considerable increase in the dominance of single species, *Heteronychia obscurata* (especially during 1984 — see Table 3—7 and Fig. 7). The diversity of culturophilous taxa ("Kulturfolger") shows considerable year-to-year oscillations however on a generally decreasing trend. The diversity of anthropotolerant species remained fairly balanced but comparatively low during entire study period. Similarly, their diversity at second classification level appears to have been rather balanced during the entire period showing only an indistinct peak during 1981 and keeping on a slightly decreasing trend (Fig. 19).

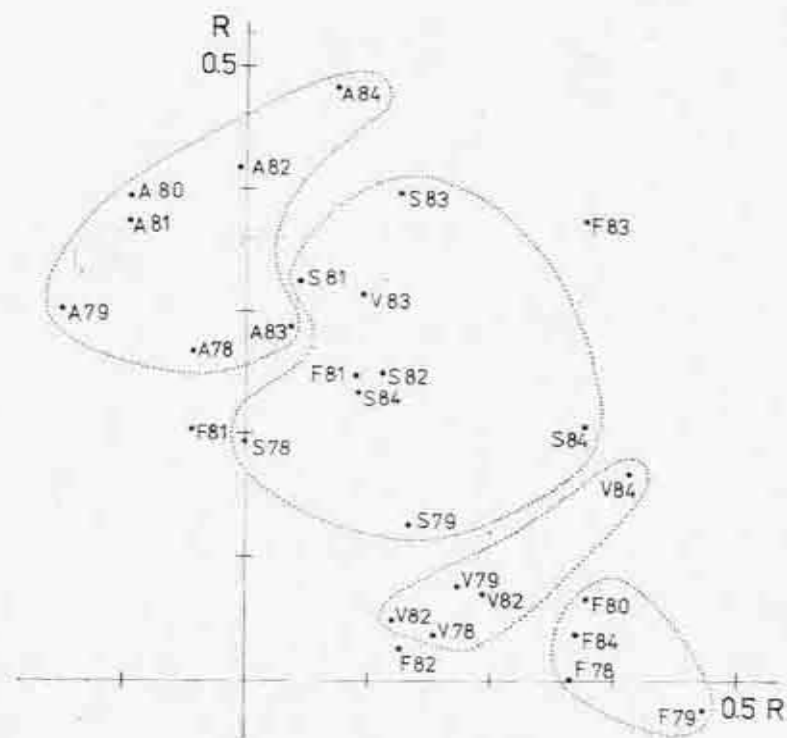


Fig. 10: Polar ordination of the individual aspects of the community studied during 1978–1984 according to dominance identity (abbreviations as in Fig. 5 and Fig. 8 respectively).

TABLE 5

Dominance and frequency of Sarcophagidae in aestival aspect in the lowland forest near Nejde

Species	1978		1979		1980		1981		1982		1983		1984	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F
<i>S. lehmanni</i>	28.08	40.00	20.28	36.80	20.11	33.87	19.31	23.80	24.10	30.33	33.00	60.60	17.55	29.50
<i>H. rohndendor-</i> <i>fiana</i>	20.46	29.14	32.02	58.10	25.38	42.75	24.18	29.80	19.60	24.66	11.98	22.00	19.74	33.16
<i>S. schulzi</i>	6.61	9.42	7.99	14.50	6.38	10.75	5.19	6.39	6.49	8.16	6.75	12.40	4.26	7.16
<i>H. haemorrhoid-</i> <i>alis</i>	3.30	4.70	7.77	14.10	4.60	7.75	4.87	6.00	1.58	2.00	5.88	10.80	2.77	4.66
<i>H. vagans</i>	5.61	8.00	7.44	13.50	5.64	9.50	8.60	10.60	6.75	8.50	6.20	11.40	4.56	7.66
<i>B. roesellei</i>	3.30	4.71	2.20	4.00	5.41	9.12	0.97	1.20	5.56	7.00	4.03	7.39	2.48	4.16
<i>S. carnaria</i>	2.30	3.28	2.26	4.10	4.67	7.87	4.05	5.00	3.44	4.33	3.81	7.00	0.89	1.50
<i>T. incisilobata</i>	5.71	8.14	4.02	7.30	3.48	5.87	4.38	5.40	1.58	2.00	1.63	3.00	3.37	5.66
<i>B. noverca</i>	2.90	4.14	2.31	4.19	4.23	7.12	4.38	5.40	5.43	6.83	3.81	7.00	3.37	5.6
<i>S. subvicina</i>	2.30	3.28	1.32	2.40	1.55	2.62	2.11	2.60	0.79	1.00	0.76	1.40	1.19	2.00
<i>H. boettcheriana</i>	0.10	0.14	3.14	5.70	6.90	11.65	8.60	10.60	9.93	12.50	6.10	11.20	2.28	3.83
<i>R. scoparia</i>	5.81	8.28	1.21	2.20	1.10	1.87	1.62	2.00	2.25	2.83	1.52	2.80	1.88	3.16
<i>H. obscurata</i>	1.60	2.28	1.54	2.80	3.56	6.00	5.68	7.00	6.09	7.66	5.01	9.20	25.29	42.50
<i>P. emdeni</i>	2.00	2.85	1.54	2.80	0.59	1.00			0.52	0.66	1.41	2.60	2.08	3.50
<i>H. proxima</i>	1.90	2.71	2.92	5.30	0.66	1.12	1.78	2.20	1.85	2.33	2.50	4.60	3.47	5.83
<i>B. subulata</i>	1.30	1.85	0.49	0.90	2.86	4.87	2.27	2.80	2.38	3.00	2.39	4.40	1.19	2.00
<i>P. aratrix</i>	1.80	2.57	0.49	0.90	1.03	1.75	0.32	0.39	0.13	0.16	0.21	0.39	0.09	0.16
<i>P. similis</i>	3.61	5.14			0.44	0.75	0.81	1.00	0.79	1.00	0.32	0.60	1.98	3.33
<i>H. nigricaudata</i>			0.22	0.39	0.89	1.50					1.74	3.19	0.29	0.50
<i>P. granulata</i>	0.20	0.20	0.66	1.20	0.29	0.50	0.32	0.39						
<i>P. albiceps</i>	0.10	0.14					0.16	0.19			0.43	0.79		
<i>P. portschinskyi</i>	0.10	0.14	0.11	0.19					0.26	0.33	0.10	0.19	0.39	0.66
<i>K. schuetzei</i>	0.10	0.14			0.07	0.12	0.16	0.19						
<i>H. haemor-</i> <i>rhoides</i>							0.16	0.19	0.26	0.33			0.09	0.1
<i>B. haemorrhoi-</i> <i>dalis</i>	0.40	0.57												
<i>P. tuberosa</i>	0.20	0.28												
<i>P. protuberans</i>											0.10	0.19		
<i>B. melanura</i>	0.10	0.14									0.10	0.19		
<i>R. striata</i>													0.09	0.16
<i>P. harpax</i>									0.13	0.16				
<i>H. nejdekensis</i>													0.09	0.16
<i>P. nemoralis</i>											0.10	0.19		
<i>H. dissimilis</i>													0.09	0.16
Samples number	7		10		8		5		6		5		6	
Individuals total	997		1814		1347		616		755		918		1008	
Individuals per sample	142.4		181.4		168.4		123.2		125.8		183.6		168	
Species total	25		20		21		21		21		24		24	
Alpha diversity H'	3.47		3.21		3.49		3.47		3.45		3.47		3.38	

Explanations: D — dominance, F — frequency.

The anthropic influences became apparent, in the middle of the study period, by an increasing overlap of both qualitative and quantitative representation of taxa within their individual synecological groupings. This increasing overlap is due to the suppression of the quantitative representation

of synecological groups obviously favoured at the beginning of the study period, as well as due to their similar suppression at its end. This quantitative representation thus approached, in the middle of the study period, their qualitative representation, the latter being rather constant during the entire

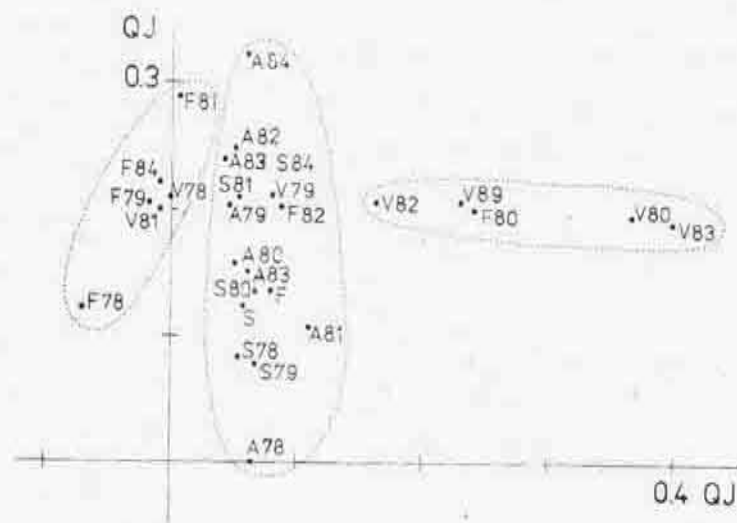


Fig. 11: Polar ordination of the individual aspects of the community studied during 1978 to 1984 according to abundance affinity (abbreviations as in Fig. 5 and Fig. 8 respectively).

study period. It seems that this overlap might either persist at lower values in future or it might decrease further on. Similar changes will depend on the obviously unpredictable trend of the possible changes resulting from the draining and subsequent aridization of the area.

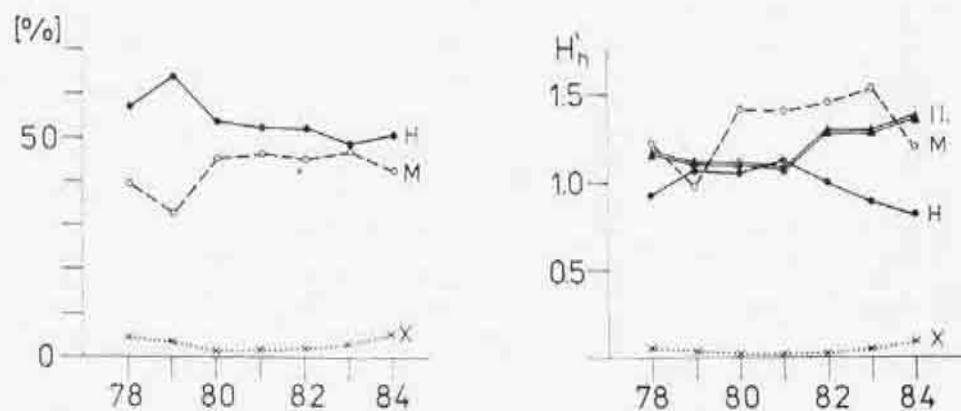


Fig. 12: Percentage of hygrophilous (H), mesophilous (M) and xerophilous (X) species during the study period 1978–1984. Fig. 13: Hierarchic diversity (H_h) of hygrophilous, mesophilous and xerophilous species (Hh-diversity on second classification level; other abbreviations as in Fig. 12).

TABLE 6

Dominance and frequency of Sarcophagidae in serotinal aspect in the lowland forest near Nejdeh

Species	1978		1979		1980		1981		1982		1983		1984	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F
<i>S. ichmanni</i>	31.73	68.75	43.22	93.75	26.57	52.88	12.33	15.16	29.43	44.00	18.27	17.40	44.40	40.12
<i>H. rohdenstor-</i> <i>fianni</i>	17.25	37.37	5.93	12.85	5.24	10.44	6.09	7.50	3.34	5.00	8.40	8.00	4.93	5.12
<i>S. schulzi</i>	9.92	21.50	11.18	24.25	17.97	35.77	19.51	24.00	15.38	23.00	17.43	16.60	9.74	10.12
<i>H. haemorrhoid-</i> <i>es</i>	8.85	19.25	8.35	18.12	1.61	3.22	7.72	9.50	1.67	2.50	4.83	4.60	0.24	0.25
<i>H. vagans</i>	5.36	11.62	5.64	12.25	4.41	8.77	6.36	7.83	4.01	6.00	5.25	5.00	4.57	4.75
<i>H. vossellii</i>	3.05	6.62	3.91	8.50	8.31	16.55	1.89	2.33	4.23	6.33	2.94	2.80	2.76	2.87
<i>S. curvata</i>	3.00	6.50	2.99	6.50	6.92	13.77	7.72	9.50	7.13	10.66	2.73	2.60	2.16	2.25
<i>T. incisulobata</i>	2.30	5.00	0.92	2.00	3.51	7.00	1.21	1.50	6.57	9.83	2.73	2.60	2.16	2.25
<i>B. novae</i>	2.42	5.25	2.24	4.87	4.52	9.00	5.14	6.33	6.02	9.00	8.40	8.00	1.80	1.87
<i>S. subvicini</i>	2.42	5.25	3.74	8.12	5.52	11.00	1.35	1.66	3.34	5.00	1.47	1.40	1.20	1.25
<i>H. boettcheriana</i>	0.80	1.75	1.21	2.62	6.08	12.11	16.80	20.66	7.80	11.66	6.72	6.39	0.36	0.37
<i>R. scoparia</i>	3.51	7.62	2.19	4.75	1.22	2.44	1.76	2.16	2.67	4.00	0.21	0.19	3.36	3.50
<i>H. obscurata</i>	1.90	4.12	2.88	6.25	3.74	7.44	8.13	10.00	2.89	4.33	12.39	11.80	13.23	13.75
<i>P. emilei</i>	2.94	6.37	1.78	3.87	0.94	1.88	6.67	0.83	1.22	1.83	1.26	1.20	3.61	3.75
<i>H. proxima</i>	1.44	3.12	0.63	1.37	0.22	0.44	1.08	1.33	0.22	0.33	1.47	1.40	0.36	0.37
<i>B. subulato</i>	0.57	1.25	1.21	2.62	1.00	2.00	1.08	1.33	1.67	2.50	0.63	0.60	1.80	1.87
<i>P. atrix</i>	1.03	2.25	0.86	1.87	0.78	1.55	0.27	0.33	0.22	0.33			0.60	0.62
<i>P. similis</i>	0.80	1.75			0.11	0.22	0.13	0.16	0.44	0.66	2.10	2.00	0.72	0.75
<i>H. nigricaudata</i>			0.40	0.87	0.33	0.66			0.33	0.50	1.68	1.59		
<i>P. granulata</i>			0.11	0.20	0.16	0.33			0.11	0.16				
<i>P. albiceps</i>	0.34	0.75	0.17	0.37	0.50	1.00	0.27	0.33	0.33	0.50				
<i>P. portschin-</i> <i>skyi</i>	0.11	0.25	0.05	0.12	0.16	0.33			0.55	0.83	0.84	0.79	1.68	1.75
<i>K. schuetzei</i>	0.05	0.12			0.05	0.11	0.13	0.16						
<i>H. haemorrhoid-</i> <i>es</i>							0.13	0.16						
<i>H. haemorrhoid-</i> <i>es</i>														
<i>P. nigritarsis</i>	0.05	0.12	0.11	0.25					0.11	0.16				
<i>P. tuberosa</i>			0.05	0.12					0.11	0.16				
<i>H. striata</i>			0.05	0.12			0.13	0.16						
<i>P. harpur</i>			0.05	0.12										
<i>H. nejdensis</i>									0.11	0.16			0.24	0.25
<i>H. dissimilis</i>											0.21	0.19		
Samples														
number	8		8		9		6		6		5		8	
Individuals														
total	1733		1735		1791		738		817		476		831	
Individuals per														
sample	216.6		216.9		199		123		136.2		95.2		103.9	
Species total	22		25		23		22		25		20		20	
Alpha														
diversity H'	3.31		3.07		3.45		3.51		3.48		3.60		2.95	

Explanations: D — dominance, F — frequency

(4) Changes of secondary production (Tables 3–7, Fig. 20)

The anthropic influences in the lowland forest complex studied manifested themselves even in the production of the sarcophagid community. The numbers of individuals netted during 1978 was 3043 and increased to nearly

4000 individuals during 1979. It dropped during 1980 to only 3232 individuals. In the following years a rapid decrease followed, reaching its minimum during 1981 with only 1488 individuals, and with a slight increase up to 1984 with 1968 individuals. Differences in secondary production were also found in the effectiveness of one-hour sampling which yielded about 100

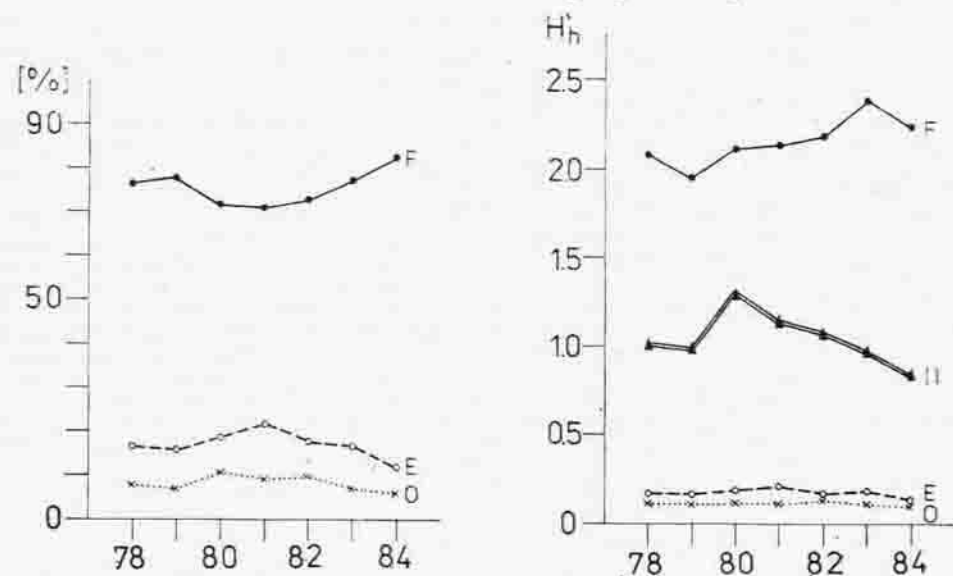


Fig. 14: Percentage of forest (F), eurytopic (E) and open landscape (O) species during the study period 1978–1984. Fig. 15: Hierarchic diversity (H'_h) of forest (F), eurytopic (E) and open landscape (O) taxa during the study years 1978–1984 (II-diversity on second classification level).

flies during 1978 (Fig. 20), the numbers decreasing up to 1982 (60 individuals/hour). During 1983–1984 the sampling effectiveness increased up to 80 individuals/hour (Fig. 20). This trend is apparently connected with the population dynamics of such species as *Sarcophaga lehmanni*, *Parasarcophaga emdeni*, and especially with a progressive decrease in such stenotopic taxa as *Heteronychia rohdendorffiana*, *H. haemorrhoea*, contrasting with an increase in the individual numbers of mesophilous *Heteronychia obscurata*. The decrease in the above species was softened, in the middle of the study period, by a moderate increase in *Sarcophaga schulzi*, *S. carnaria* and *Heteronychia boettcheriana*. This trend coincides, further on, with the development of woodland species diversity and numbers. It also indicates a slight coincidence with the diversity development depending on humidity at the second classification level.

(5) Changes of alpha diversity (Tables 3–7)

There do not seem to occur any striking changes in the development of alpha diversity during entire study period. Some minor differences in the course of this index may be due to the inevitable factor oscillations or even

TABLE 7
Dominance and frequency of Sarcophagidae in autumnal aspect in the lowland forest near Nejdek

Species	1978		1979		1980		1981		1982		1983		1984	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F
<i>S. lehmanni</i>	40.88	24.66	91.06	88.33	52.08	8.33	24.62	9.00	32.22	4.14	24.80	10.66	62.88	30.50
<i>H. rohdendorffiana</i>	0.55	0.33									1.55	0.66		
<i>S. schulzi</i>	25.41	15.33	3.43	3.33	16.66	2.66	28.76	10.50	27.77	3.57	13.95	6.00	10.30	5.00
<i>H. haemorrhoea</i>							1.36	0.50						
<i>H. vagans</i>	1.10	0.66					1.36	0.50	3.33	0.42	0.77	0.33	7.21	3.50
<i>B. roesslii</i>					6.25	1.00	4.10	1.50			4.65	2.00		
<i>S. carnaria</i>	1.65	1.00	1.03	1.00	8.33	1.33	2.73	1.00	25.55	3.28			5.15	2.30
<i>T. incisilobatus</i>	3.31	2.00	0.68	0.66			1.36	0.50	1.11	0.14	3.10	1.33		
<i>H. noverca</i>							1.36	0.50			1.55	0.66		
<i>S. subvicina</i>	8.83	5.33	1.71	1.66	6.25	1.00	2.73	1.00			1.55	0.66	4.12	2.00
<i>H. boettcheriana</i>					4.16	0.66	4.10	1.50			3.10	1.33	1.03	0.50
<i>R. scoparia</i>	9.39	5.66	0.68	0.66	6.25	1.00	21.91	8.00	10.00	1.28	17.82	7.66	3.00	1.50
<i>H. obscurata</i>											12.40	5.33		
<i>P. emdeni</i>	4.41	2.66	1.37	1.33							2.32	1.00	3.00	1.50
<i>B. subulata</i>							2.73	1.00			4.65	2.00	3.00	1.50
<i>P. aratrix</i>	0.55	0.33												
<i>P. similis</i>											6.97	3.00		
<i>H. nigricaudata</i>							2.73	1.00						
<i>P. albiceps</i>	0.55	0.33									0.77	0.33		
<i>P. portachinskyi</i>	3.31	2.00												
Samples number	3		3		3		2		7		3		2	
Individuals total	181		291		48		73		90		129		97	
Individuals per sample	60.3		97		16		36.5		12.9		43		48.5	
Species total	12		7		7		13		6		15		9	
Alpha diversity H'	2.47		0.64		2.16		2.78		2.11		3.22		1.97	

Explanations: D — dominance, F — frequency

to subjective influences. Although one would expect a decrease in alpha diversity during the entire study period in view of the progressive anthropic degradative interference (see ODUM, 1977; POVOINY & ŠUSTEK, 1983a; ŠUSTEK, 1984) no such trend was observed, obviously due to a distinct convergence of this lowland forest community with that of a mesophilous deciduous forest of the 1st–2nd vegetation tiers. The decrease expected in the alpha diversity was balanced by the increased representation of non-woodland species in the middle of the study period and by a similar increase in the mesophilous woodland taxa at its end. These changes are interpreted in the previous chapter devoted especially to the problem of hierarchic diversity (Figs. 12–19). The expected decrease in alpha diversity is presented by the considerable species richness of the community studied as well as by its considerable ecological differentiation, combined with occasional host non-specificity of parasitoids. The obvious degradation of the community could be still compensated by the shifting of the individual synecological groups,

The question arises of how long such shifts might be possible or effective. For the time being, the considerable constancy of dominant taxa seems to warrant a possible restructuralization of the community, especially considering further possible changes of the forest stand in some other respect. The highly sensitive stenotopic (discriminating) taxa, such as *Pierretia granulata*, *Heteronychia haemorrhoea*, seem to have become extinct.

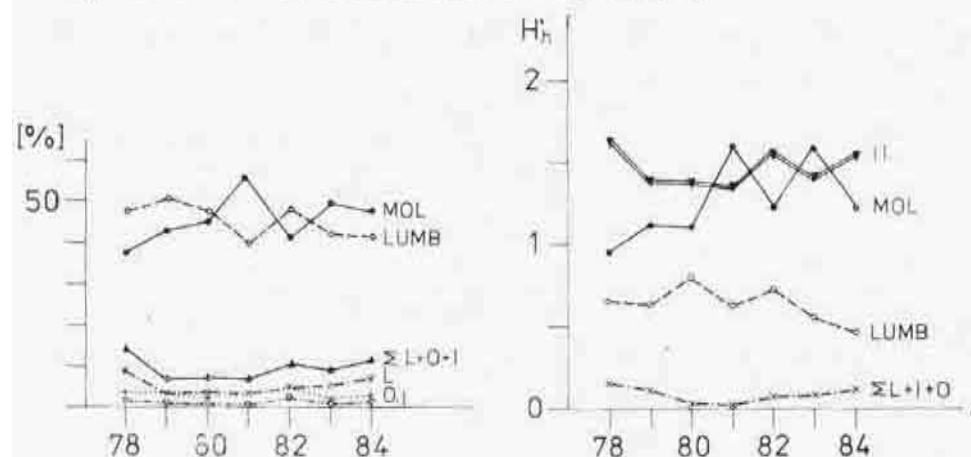


Fig. 16: Percentage of individual host groups during the study period 1978–1984; parasitoids of molluscs (MOL); earthworms (LUMB); lepidopterous larvae (L); Orthoptera (O) and of other insects (I). Fig. 17: Hierarchic diversity (H'_h) of host groups during the study period 1978–1984. Abbreviations as in Fig. 16.

In summing up one can state that both the overlap of qualitative and quantitative representation of taxa (Fig. 21) and the trend in alpha diversity of the community evidence a distinct degradation of the lowland forest sarcophagid community and its convergence towards a mesophilous woodland community such as those existing yet in dry habitats of southern Moravia, and the decline of its original character.

Appendix

The influence of certain objective and possibly even subjective factors, represented primarily by the duration of sampling, on the static characteristics of the community can be demonstrated on the material sampled during 1979 (Fig. 21). This season was representative both as regards the almost unchanged character of the habitat including its humidity and mesoclimate in general, and the material sampled. It results from the factor analysis that the sampling time correlates with the number of individuals netted. The correlation between sampling duration and number of taxa collected seems to be less apparent. The duration of sunshine appears to be of minor, or at least indirect, importance, although the absence of sunshine stops flight activity. The sampling duration did not essentially influence alpha diversity and the equitability of the community studied. These values are, however, positively related with the average daily temperature showing only loose relation to the daily temperature minima. The size of the dominance con-

centration index shows a similar relation to the sampling duration as the diversity indices, as evidenced by their approximately identical position along the second ordination axis (Fig. 22). In view of the reciprocal values of this index in relation to the diversity indices (Simpson's index indicating second order entropy and hence showing reciprocal values as compared with

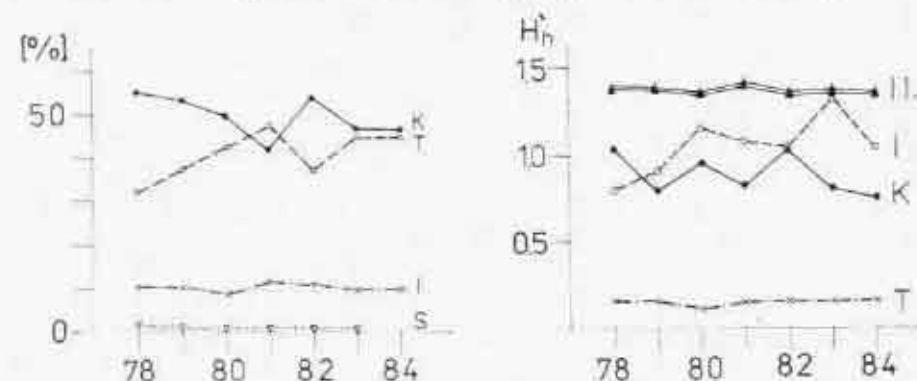


Fig. 18: Percentage of individual groups according to anthropic interference during 1978 to 1984. I — anthropointolerant, T — anthropotolerant, K — culturophilous ("Kulturfolger"), S — synanthropic taxa. Fig. 19: Hierarchic diversity (H'_h) of individual groups according to anthropic interference. (Abbreviations as in Fig. 18). Synanthropic taxa are not visualized due to their zero diversity.

Shannon's index which indicates first order entropy) it is situated on the negative side of the ordination axis (Fig. 22). Precipitation correlated with sunshine and their influence on the number of individuals and taxa sampled appears to be indirect, being mediated by the duration of sampling.

CONCLUSIONS

The extensive water management of the lowland forest territory of southern Moravia started in 1973 and, combined with an apparent decrease in precipitation which occurred during the late seventies, reflected itself in the composition of the sarcophagid community studied. The quantitative representation of taxa and the diversity of the community decreased. The existing changes favoured taxa characteristic of woodland taxocenoses of 1st and 2nd vegetation tiers. The essential qualitative representation of taxa remained little changed but the most sensitive (bioindicative) species disappeared. The above changes seem to accompany a starting secondary succession resulting from anthropic pressures. Due to further intensification of agriculture and obvious aridization of the territory one might expect that the representation of culturophilous forms will increase, as already evidenced by this trend during the early eighties when (irrespective of extremely hot vernal aspects of the years 1978–1979) (Figs. 1–3) the community was deeply stressed. This might also have been correlated to the decreased water supply of the river Dyje due to a gradual filling of two dams several kilometres up-stream. The development of both local climate and of the community studied (Figs. 1–3 and 7) seem to indicate, however, that such very wet seasons as 1984 might soften this general trend.

Although our observations lasted essentially longer than those arranged within such programmes as IBP and/or MaB, the final state of this development appears to be unpredictable. This situation appears to be the more complicated as the lowland forest communities of animals, especially of insects, are extremely sensitive and inconstant, their recovery being possible apparently within a limited space of time.

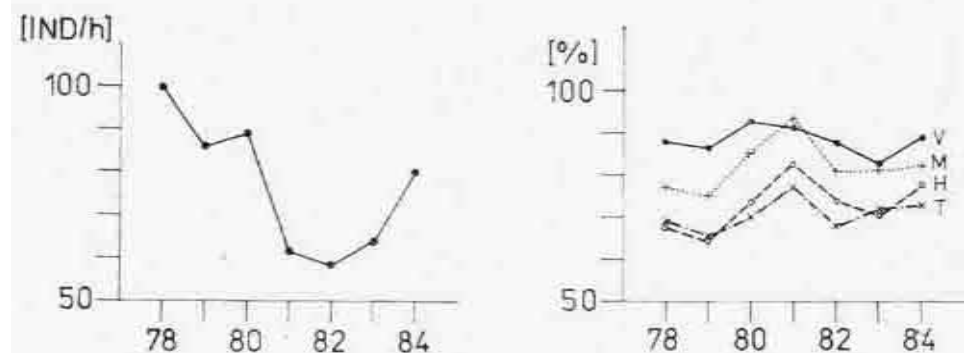


Fig. 20: Effectiveness of one hour sampling during the study period 1978–1984. Fig. 21: Overlap of qualitative and quantitative distribution of the individual ecological groups of Sarcophagidae. (V – vegetation cover; M – relation to anthropic interference; H – relation to humidity; T – trophic relations).

Finally, this paper shows how problematic the results of generalized studies of lowland forest Diptera (and probably the insects generally) might be when based on non-specialized sampling methods. VAÑHARA (1981a) for instance found only three individuals (representing three species) of Sarcophagidae from among 47 families, 235 genera and 449 species represented by about eleven thousand individuals of cyclorrhaphous Diptera collected during two vegetation periods of 1971–1972. The specialized sampling method respecting ethological manifestations of Sarcophagidae (as applied in this paper) produced an annual average of about 4800 individuals over two years representing up to about 30 species.

It should be finally emphasized that a general unpredictability of sarcophagid community trends (as pars pro toto) seems to result from our investigation and that this trend will obviously offer new problems in connection with the aridization of the entire territory.

Generally the essential conclusions of this paper accord with observations of structure and dynamics of long-term investigations in certain other animal groups in the same locality: In Carabidae and Staphylinidae many species characteristic of a lowland forest, such as *Bembidion unicolor*, *B. biguttatum*, *Pterostichus nigrita*, *Agonum moestum* and especially *Staphylinus erythropterus* have disappeared from the former inundated territory, where they flourished previously. Formerly common species such as *Agonum assimile* and *Carabus granulatus* have become rare. Instead, mesophilous forms such as *Carabus ullrichi* and *Abax ater* dominate this association. As for small mammals an obvious decrease in densities of insectivores such as Soricidae is apparent.

Also mosquitoes and biting flies such as Culicidae and Tabanidae have decreased so substantially as to no longer to be a serious nuisance. The continuous sampling of Sarcophagidae during 1985, another pluvial season, confirms our former statements. A certain increase in characteristic taxa (e.g. *Heteronychia rohdendorfi*, *Sarcophaga lehmanni*, etc.) was observed, but the most sensitive species (*Pierretia granulata*) disappeared, and the general densities of taxa characteristic of this community formerly were not reached.

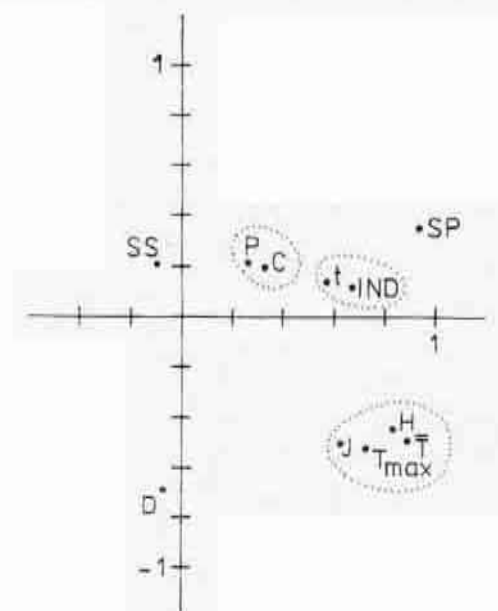


Fig. 22: Factor analysis of some abiotic factors and static characteristics of the community studied during the year 1979. (SS – sunshine; P – precipitation; t – sampling time; C – cloudiness; T – mean daily temperature, T_{max} – maximum daily temperature; IND – Individuals number; H – alpha diversity; J – equitability; D – dominance concentration).

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Влияние изменений уровня подземной воды на сообщества Sarcophagidae (Diptera) в средневропейском пойменном лесу

Экология, динамика и структура сообществ, сезонные аспекты, ординация, иерархическая классификация, иерархическая разнообразие, осушение

Резюме. В период 1978—1984 гг. изучались изменения в структуре и динамике сообществ Sarcophagidae в пойменном лесу, обусловленные осушением. Снижение уровня подземной воды проявилось несколькими выразительными изменениями, напр. в количественном замещении таксонов и в разновидности сообщества. Экологически чувствительные таксоны (биоиндикаторы) показывают снижение количественности или вообще исчезают. В течение последних лет можно наблюдать определенное количественное нарастание толерантных таксонов, при чём менялся исходный характер сообщества,

состав которого приближается сообществам окрестных более сухих порослей. Хотя наблюдение долгосрочное, нельзя предвидеть конечное состояние наблюдаемой ре-сукцессии. Сравнение этих результатов основанных на долгосрочном наблюдении избранной модельной группы насекомых с краткосрочным наблюдением таксономически более широких групп (напр. отрядов или семейств насекомых), основанных на не-специализированных методах сбора показывает, что последний названный подход дает проблематические результаты.

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