Zoocoenological pattern of bug assemblies (Heteroptera: Gerromorpha, Nepomorpha, Leptodomorpha) in the Szilas- and Gyáli Streams, Hungary

By

L. HUFNAGEL* and E. STOLLMAYERNÉ BONCZ**

Abstract. Quantitative data on the species composition of bug communities are presented. Field sampling was carried out at six locations along two streams in Hungary, between 1993 and 1995. Diversity, water quality, and vegetation composition were compared. A relationship was found between the density of algae and the composition of bug communities.

The investigation of the composition of bug assemblies in wet habitats dates back to the turn of the century in Hungary. These early reports, though, usually contain only species lists based on the imagos. A lot of information can be obtained from these lists on the biogeography and ecology of species, moreover, they can be used for synbiological indication as well (Hufnagel & al., 1997, 1998). To monitor small changes or to explore finer patterns, however, it is necessary to take habitat characteristics as well as species abundances and larvae into account. Very few studies of this kind have been conducted up to now (Moldoványi, 1977, 1984).

Materials and methods

Field sampling was carried out in 3-3 sections (100 m each) of two streams, the Szilas Stream in the north-east of Budapest, and the Gyáli Stream in the south-east of Budapest. Each section was selected to be homogeneous. One of them was located close to the source, another one was close to the mouth, and the third one in between for both streams. The selection of the study areas was based on preliminary surveys. The location and marking of the sampled sections are shown in Figure 1. All of the sections were sampled monthly from March to November, and cumulative data were used for the characterization of a particular site. In each section, smaller areas

**Levente Hufnagel*, ELTE Állatrendszertani és Ökológiai Tanszék, MTA Zootaxonómiai Kutatócsoport (Department of Systematic Zoology and Ecology of the Eötvös Loránd University, Zootaxonomy Research Group of the Hungarian Academy of Sciences), 1088 Budapest, Puskin u. 3, Hungary.

***Emília Stollmayerné Boncz*, Magyar Természettudományi Múzeum Növénytára (Department of Botany of the Hungarian Natural History Museum), Budapest, Könyves Kálmán krt. 40, Hungary.

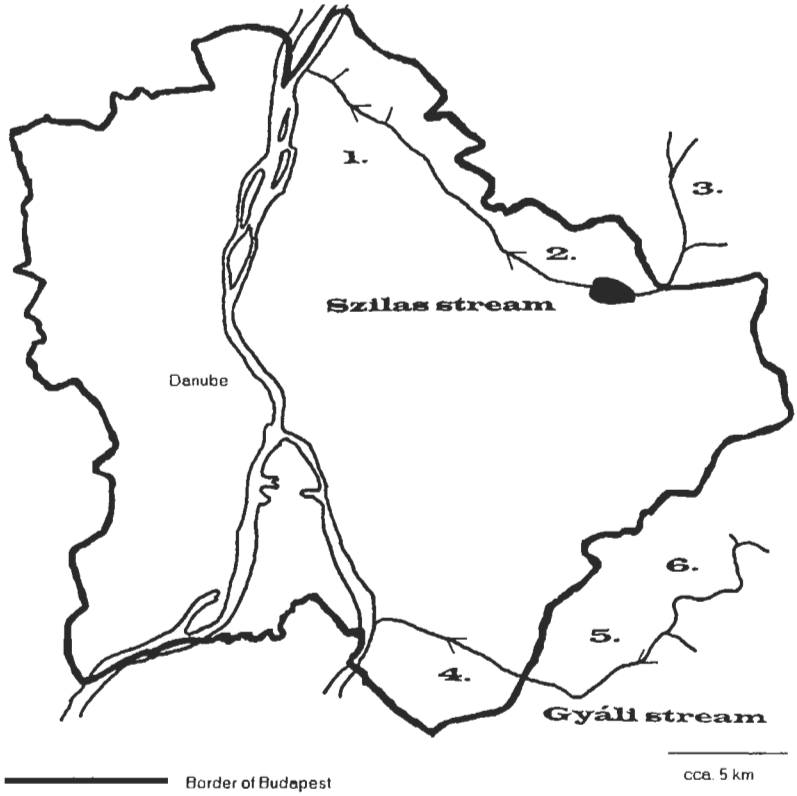

Fig. 1. Location of the sampling sites (sections)

were closed impermeably for bugs, and all the bugs found within these sub-areas were collected. At the same place and time, habitat and water quality characteristics were measured. In addition, cumulative plant species list was made including the species found in, along, and above the water. For the identification of bugs, the works of Benedek (1969), Jansson (1969, 1986), Péricart (1990), Savage (1989), Soós (1963), Stusak (1980), Väpseläinen and Krajewski (1986) and Vásárhelyi (1990) were used, species names are given according to Aukema and Rieger (1995). The nomenclature of plant species follows Simon (1992). Water quality characteristics were measured according to Felföldy (1987), except for Na^+ and Cl^- concentration, which were measured using Radelkis ion-selective electrodes. The percentage cover of the herb layer was estimated for the open water and the shore, and tree canopy cover was estimated above the water each time.

In the analysis of the quantitative data of the bug communities, relative frequencies of the species were used to account for the differences among habitats. To explore similarity relations, metrical multidimensional scaling was applied based on Euclidean distance. The program package used was SYNTAX (Podani, 1993, 1997). To compare diversity relations, Rényi's diversity ordering was applied using NuCoSa program package (Tóthmérész, 1996, 1997).

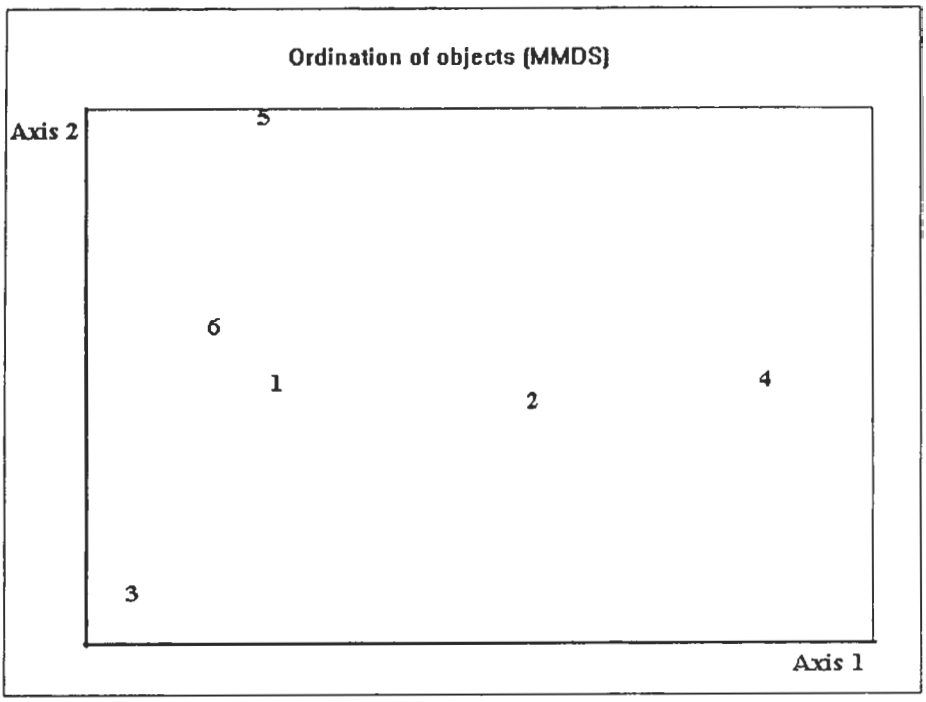

Fig. 2. Similarity pattern of sampling sites (sections)

Results

The faunistic, florist, water quality data and additional characteristics are presented in tables. In the columns of all the three tables, serial numbers refer to the sampling areas, and these numbers are the same as in Figure 1.

Table 1 contains habitat parameters. These parameters varied greatly during the study period, therefore, only their minima and maxima are shown in the table. It can be seen that the sections of the Gyáli Stream are significantly different from one another in terms of hydrological characteristics, whereas those of the Szilas stream are more similar. The Gyáli Stream seems to be more polluted even based on the saprobity and tropihty. The low number of algae in Section 4 can be misleading because of the intense eutrophication caused by *Lemna minor* in this study area.

Table 3 contains florist data. As expected, there is a high degree of similarity among the species lists: all the study areas are dominated by species of wet habitats (W value of 7–11) that favour calcareous soil (R value of 4) and deciduous forest climate, and have an Eurasian–Mediterranean distribution or are cosmopolitan. In Sections 2, 4, and 5, species characteristic of natural communities, while in Sections 1, 3, and 6 species characteristic of degraded communities are more abundant. Concerning species richness, Section 5 is the richest and Sections 3 and 6 are the poorest.

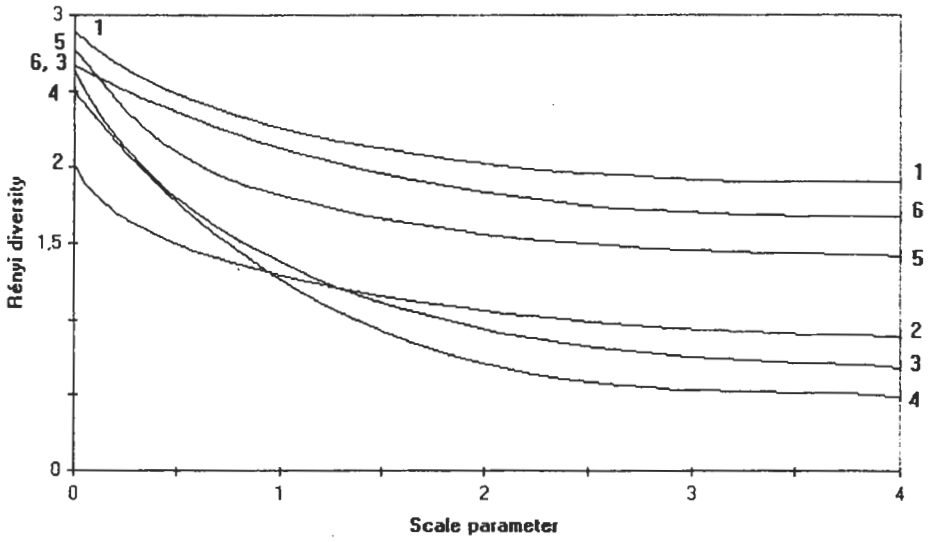

Fig. 3. Diversity ordering of sampling sites (sections)

Data on bugs are summarized in Table 2. The first numbers apply to the imagoes and the second ones to the larvae. It can be seen, that the imagoes and larvae of the same species have different meanings. Moreover, in some cases, only one of the two occurs. This latter fact emphasizes the importance of larva identification, which also has to be considered when interpreting data found in the literature.

Figure 2 shows the similarity pattern of the study areas (ordination based on dominance values). No segregation or grouping can be found based on the twostreams or in any other manner, thus the study areas should be characterized one by one.

Rényi's diversity ordering was applied for the comparison of diversities. Figure 3 shows that Section 1 is the most diverse, Sections 5 and 6 cannot be ordered relative to each other, but both of them are more diverse than Sections 2, 3, and 4. Section 3 is more diverse than Section 4, but neither of the two can be ordered relative to Section 2. Altogether, concerning the rare species, the increasing order of diversity is: 2, 4, 3, 6, 5, 1, while concerning the frequent species it is: 4, 3, 2, 5, 6, 1. This difference draws the attention to the fact, that applying simple diversity indices may lead to misinterpretation. The three most diverse sections are also close to one another in the ordination diagram.

During earlier studies at Lake Balaton, a possible relationship was hypothesized between TCV values (Total Coenological Value) used for the characterization of bug communities and the trophity (Hufnagel & al., 1998). For the first time, present data sets make it possible to calculate weighted averages (weighted by the dominance) from the species specific indicator values (CV), and to compare these to alga densities. Table 2 shows the weighted CV averages obtained. Both the CV average and the alga density values reach their maxima at Sections 5 and 6 and reach their minima at Section 3. This finding seems to support the above hypothesis.

Additional investigations are necessary for the ecological interpretation of he zoocoenological patterns (present and earlier relationships) described in the present paper. By publishing the above data we would like to promote these.

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Table 1. Habitat charachteristics in the sampling sites

	Sampling sites					
	1	2	3	4	5	6
Width (cm)	100-215	180-250	200-250	400-500	280-400	50-200
Depth (cm)	8-30	15-35	15-40	40-100	20-80	10-40
Water current (m/s)	0,01-0,33	0,02-0,30	0,01-0,19	0,00-0,20	0,00-0,33	0,05-0,40
Vegetation cover (shore) (%)	0-100	40-100	30-100	100	100	0-90
Vegetation cover (bed) (%)	0-100	40-100	0-50	5-100	100	3-30
Cover of overhanging canopy (%)	0	0-1	0-100	0-100	0	0
pH	7,99-9,00	7,79-8,30	7,80-8,35	7,35-8,20	7,70-7,99	7,50-9,10
Conductivity (mS/cm)	0,595-1,200	0,785-1,850	0,690-1,050	1,02-1,41	0,89-1,30	0,620-1,280
KOI_{Mn} (mgO/dm³)*	1,0-8,7	3,2-15,0	4,0-9,0	1,5-16,0	5,0-16,8	6,0-20,0
Cl^- (mol/dm³)	0,001-0,006	0,001-0,006	0,000-0,005	0,001-0,006	0,001-0,007	0,000-0,007
Na^+ (mol/dm³)	0,001-0,003	0,000-0,002	0,000-0,003	0,000-0,003	0,000-0,005	0,000-0,005
m-alcality	4,91-8,03	5,64-6,21	7,00-7,73	7,45-8,18	8,03-8,86	4,09-7,91
p-alcality	0	0	0	0	0	0,15-0,45
Number of algae(10^6i/dm³)	0,1-2,2	0,3-3,5	0,2-1,4	0,1-2,0	0,8-24,0	1,0-6,34

* Chemical oxygen demand

Table 2. Occurrence of bug species in the sampling sites

Taxa	Sampling sites					
	1	2	3	4	5	6
GERROMORPHA						
Gerridae						
Gerris thoracicus Schummel, 1832	14/20	3/0	16/17	8/0	41/238	21/3
Gerris lacustris (Linnaeus, 1758)	26/52	130/120	224/324	0/2	1/3	16/0
Gerris asper (Fieber, 1860)	3/27		20/38	27/1	27/166	3/1
Gerris argentatus Schummel, 1832				9/0	33/132	1/0
Gerris odontogaster (Zetterstedt, 1828)	1/0		3/0	16/0	28/7	1/0
Aquarius paludum (Fabricius, 1794)	2/0				1/0	
Limnopolus rufoscutellatus (Latreille, 1807)					1/0	
Hydrometridae						
Hydrometra stagnorum (Linnaeus, 1758)	74/20	80/7	127/76	4/0		14/1
Hydrometra gracilenta Horváth, 1899					1/1	
Veliidae						
Microvelia pygmea (Dufour,1833)	0/6	7/0	0/44			
Velia saulii Tamanini, 1947	13/9		4/0			1/0
NEPOMORPHA						
Nepidae						
Nepa cinerea Linnaeus, 1758	25/40	149/382	3/26	83/94	1/7	2/2
Notonectidae						
Notonecta glauca Linnaeus, 1758	45/3	241/1	10/21	5/0	6/401	7/1
Notonecta viridis Delcourt, 1909	1/0	5/0	1/0			1/0
Corixidae						
Sigara striata (Linnaeus, 1758)	3/1		1/0	3/3	4/106	
Sigara nigrolineata (Fieber, 1848)	2/1					
Sigara lateralis (Leach, 1810)	15/12					11/1
Sigara falleni (Fieber, 1848)				2/0		
Corixa punctata (Illiger, 1807)	1/0			1/1	2/2	0/4
Corixa affinis Leach, 1817	1/0					
Hesperocorixa linnaei (Fieber, 1848)	11/0	2/0		4/1	21/65	1/0
Hesperocorixa shalbergi (Fieber, 1848)					1/0	
Micronecta scholtzi (Fieber, 1860)	5/3					
Naucoridae						
Ilyocoris cimicoides (Linnaeus, 1758)				1/0		1/0
Pleidae						
Plea minutissima Leach, 1817					1/0	
LEPTOPODOMORPHA						
Saldidae						
Chartoscirta cincta (Herrich-Schaeffer, 1841)	10/0	1/0	7/0		12/0	
Chartoscincta elegantula (Fallén, 1807)			1/0			
Saldula arenicola (Scholtz, 1847)			2/0			
Saldula saltatoria (Linnaeus, 1758)			1/0		1/0	
Number of species	19	9	15	13	17	14
Number of individuals	453	1128	966	264	1310	95
Average of CV	-0,64	-0,77	-0,78	-0,64	-0,42	-0,56

Table 3. Plant species in the sampling sites

Taxa	Sampling sites					
	1	2	3	4	5	6
Clematis vitalba L.	x					
Ranunculus repens L.			x	x	x	x
Ranunculus acris L.						
Ceratophyllum demersum L.				x		
Trifolium pratense L.		x				
Robinia pseudo-acacia L.						x
Vicia cracca L.	x					
Vicia sativa L.					x	
Lathyrus tuberosus L.	x					
Epilobium hirsutum L.		x	x	x		
Anthriscus sylvestris (L.) Hoffm.			x			
Pimpinella major (L.) Huds.	x					
Sium erectum Huds.			x	x		
Sium latifolium L.		x				
Angelica sylvestris L.		x				
Daucus carota L.	x					
Galium aparine L.			x		x	x
Galium elongatum Presl.				x	x	
Galium rivale Sibth. et Sm..	x					
Galium mollugo L.		x			x	
Sambucus nigra L.				x		x
Euphorbia cyparissias L.					x	
Convolvulus arvensis L.	x					
Calystegia sepium (L.) R. Br.					x	
Symphytum officinale L.	x		x	x		
Anchusa offcinalis L.		x			x	
Myosotis palustris (L) Nath. em. Rchb.		x				
Mentha longifolia (L) Nath.	x	x				
Mentha aquatica L.		x			x	
Solanum dulcamara L.		x	x			
Scrophularia umbrosa Dum.		x				
Chelidonium majus L.			x			
Papaver rhoeas L.		x				x
Sinapis arvensis L.	x					
Armoracia lapathifolia Usteri	x				x	
Rorippa amphibia (L.) Bess.					x	
Erysimum diffusum Ehrh.					x	
Echinocystis lobata (Michx.) Torr. et Gray			x			
Eupatorium cannabinum L.		x				
Bidens tripartita L.	x					
Athemis austriaca Jacq.					x	
Tussilago farfara L.				x		
Tragopogon orientalis L.		x				

Cirsium arvense (L.) Scop.			x			
Taraxacum officinale Weber & Wiggers		x				
Sonchus arvensis L.	x	x				
Silene vulgaris (Mönch) Garcke	x					
Melandrium album (Mill.) Garcke	x				x	x
Stellaria media (L.) Vill.						x
Polygonum hydropiper L.	x					x
Cannabis sativa L.				x		
Urtica dioica L.	x		x		x	x
Alnus glutinosa (L.) Gartn.				x		
Salix purpurea L.				x		
Alisma lanceolatum Wth.				x	x	
Butomus umbellatus L.	x			x	x	x
Potamogeton pectinatus L.					x	
Potamogeton berchtoldii Fieber		x				
Potamogeton crispus L.	x			x		
Muscari neglectum Guss. ex Ten.						x
Iris pseudacorus L.					x	x
Juncus inflexus L.		x				
Scirpus sylvaticus L.		x				
Carex acutiformis Ehrh.		x				
Glyceria maxima (Hartm.) Holmbg.	x				x	
Glyceria fluitans (L) R. Br.				x		
Poa trivialis L.				x		x
Catabrosa aquatica (L.) P. B.				x		
Phragmites australis (Cav.) Trin.	x	x	x	x	x	
Arrhenatherum elatius (L) Presl					x	
Lemna minor L.			x	x	x	
Sparganium erectum L.					x	
Typha angustifolia L.			x	x	x	x
Number of species	21	21	15	20	25	14