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Structural Characterization of Periphyton in Kis-Balaton Protecting System

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Abstract: The study on the benthic vegetation complex (aquatic plants and their periphyton) was started in 1986. It should provide data that may significantly contribute to the recognition of changes in the Kis-Balaton Protecting System. Large mass values found in River Zala and in the upper water areas indicate the importance of the periphyton of aquatic vegetation in this system and are connected with their biofilter function. In accordance with the purification gradient low N and P contents are characteristic of the periphyton in the Sanyari water area. In the phytotecton of each aquatic plant two diatom species, *Achnanthes minutissima* and *Cocconeis placentula* can be observed in high numbers. The chemical and biological parameters of the periphyton on reed, bulrush and knot-weed indicate an oligotrophication process in the Kis-Balaton Protecting System.

Introduction

The significance of the littoral zone and the aquatic plant community especially in life of shallow lakes and reservoirs has already been recognized (Wetzel 1964, Rich et al. 1971, Kairesalo 1980) but only some papers have given detailed information about them (Meschkat 1934, Pieczynska & Szczepanska 1966, Allen & Ocevski 1981, Shamess et al. 1985, Meulemans 1988, Lakatos 1989a). The reason of it is the diverity of the littoral zone and the methodological difficulties connected with it. In the fight against the eutrophication of our waters the utilization of the macrovegetation in the littoral zone seems to be more and more important (Lakatos 1978, Lakatos et al. 1982). The under water parts of aquatic plants are covered with periphyton (Wetzel 1983), wich has an important effect on the water quality in shallow water bodies, therefore it is necessary to focus on its investigation. Due to their sessile way of life the organisms in the periphyton can be used to describe the condition of water quality and indicate its changes (Lakatos 1989b, Seki et al. 1988, 1989). The basic idea behind the establishment of Kis-Balaton Protecting System is that the water of River Zala loaded significantly by plant nutrients should not reach directly the Keszthely bay of Lake Balaton, but is should flow through the benthic vegetation complex developed in the system (Pomogyi 1986). This paper presents the main results of the study on the benthic vegetation complex, (*Phragmites australis, Polygonum amphibium, Typha latifolia* and their periphyton) performed in the present Kis-Balaton Protecting System. The study which was started in 1986 provide data that may significantly contribute to the recognition of the changes in the system and moreover to the conscious application of the hydrobiological events in practice.

Materials and methods

The water regions of the Kis-Balaton Protecting System and the sampling sites are illustrated in Fig. l. The distinction of water areas was made after Pomogyi (1986). Periphyton samples were always taken in summer when the host plants, the substrates were also collected. During the four years period samples were taken from 40 reed, bulrush and knot-weed stands in ten water areas of Kis-Balaton, namely River Zala, Bárándi-, Szabari-, Pogányvári-, Radai-, Garabonci-, Magyaródi-, Kányavári-, Sanyari water area and Kazetta. The latter one has separate water body and works as a water reservoir.

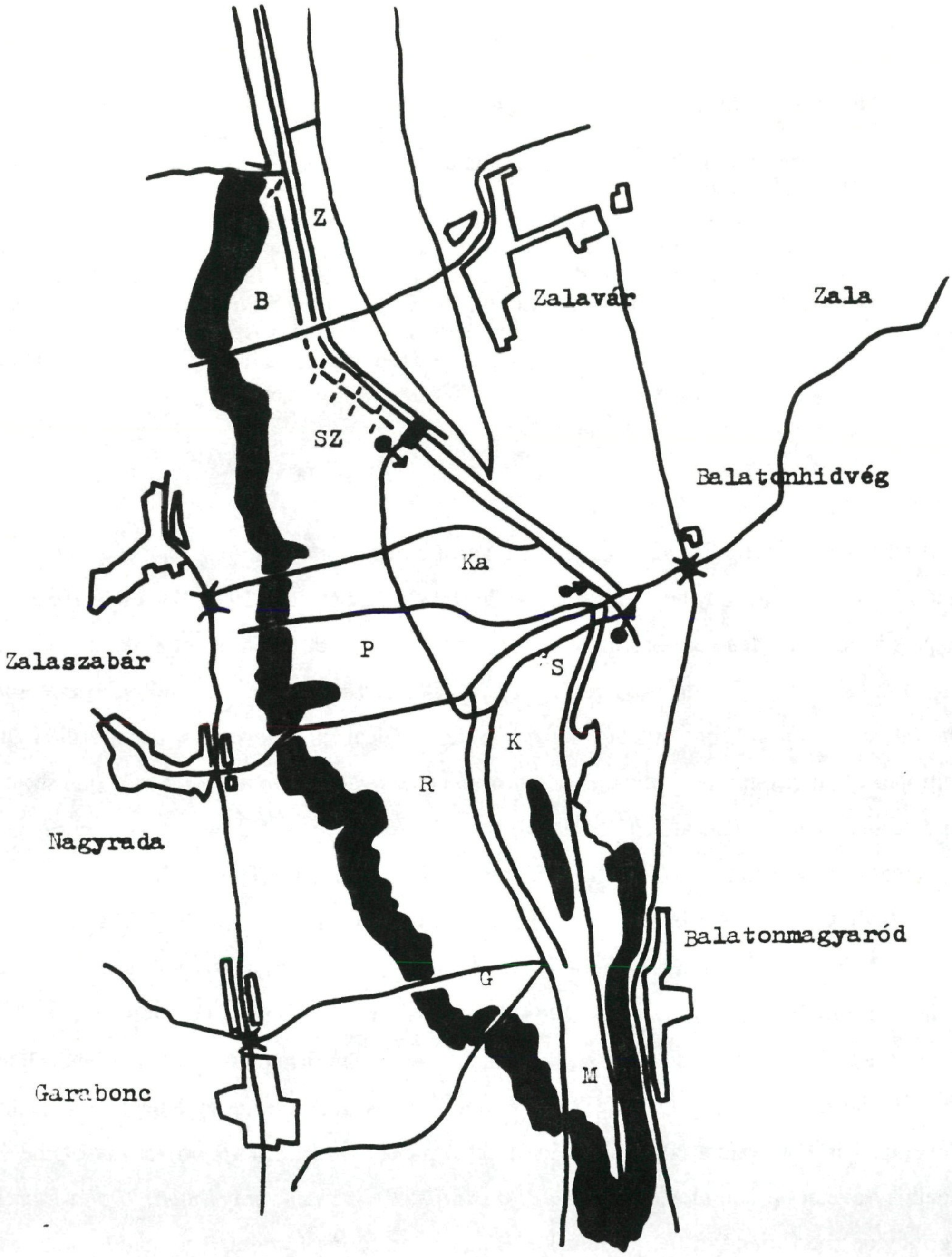

Fig. 1: Sampling sites in water areas of Kis-Balaton Protecting System

Wet and dry mass as well as the ash content of the periphyton were determined. The Chlorophyll was extracted by methanol. After measuring the concentrations of N and P we calculated the N/P ratio. The concentrations of the more important cations (sodium, potassium, calcium, magnessium, iron, manganese and zink) were determined too. During the algolocigal analysis of phytotecton the algal taxa were identified and the percentage distribution of phyla was calculated.

Based on the zootecton results a cluster analysis was applied. The mass relations and the inorganic and organic composition were used for classification of periphyton samples (Lakatos 1988).

Results and discussion

Considering the dry mass of periphyton the following groups of sampling sites can be distinquished (Table 1).

Table 1: Classification of periphyton on the basis of its dry mass

		dry mass $g.m^{-2}$
I.	periphyton of large mass	40
II.	periphyton of medium mass	20-40
III.	periphyton of small mass	20

categories

	reed-periphyton		*Polygonum*-periphyton	
I.	Z,B,Ka	(3)	Z,B,Sz,Ka	(4)
II.	Sz,M	(2)	P,R	(2)
III.	P,R,G,K,S	(5)	G,M,S	(3)
		10		9

The distribution of periphyton samples collected from the green reed and from knot-weed is demonstrated separately. The largest mass of knot-weed is demonstrated separately. The largest mass of periphyton was found in the reed stand near the bank of River Zala, it was almost twenty times higher, then the value measured in the effluent of the protecting system. The reed-periphyton in the Bárándi water area and in the Kazetta and the *Polygonum*- periphyton in the Szabari water area had a quite large mass too. The mass relations of periphyton collected from the unter water and horizontally floating shoots of *Polygonum* are in good agreement with those of green reed.

Significant mass values observed in River Zala and in the upper water areas indicate the importance of the periphyton of aquatic and marsh vegetation in this system and are connected with their biofilter function. These values can be the result of the sedimentation of the suspended solids and the favourable supply of plant nutrients.

The temporal and spatial changes in the dry weight of reedperiphyton are demonstrated in Fig. 2. In summer of the last two years the dry mass of periphyton in River Zala was smaller than in the previous years. The mass of the periphyton was higher on the old reed in comparison with green one.

The most striking difference according to the two substrates was established in the Sanyari water area.

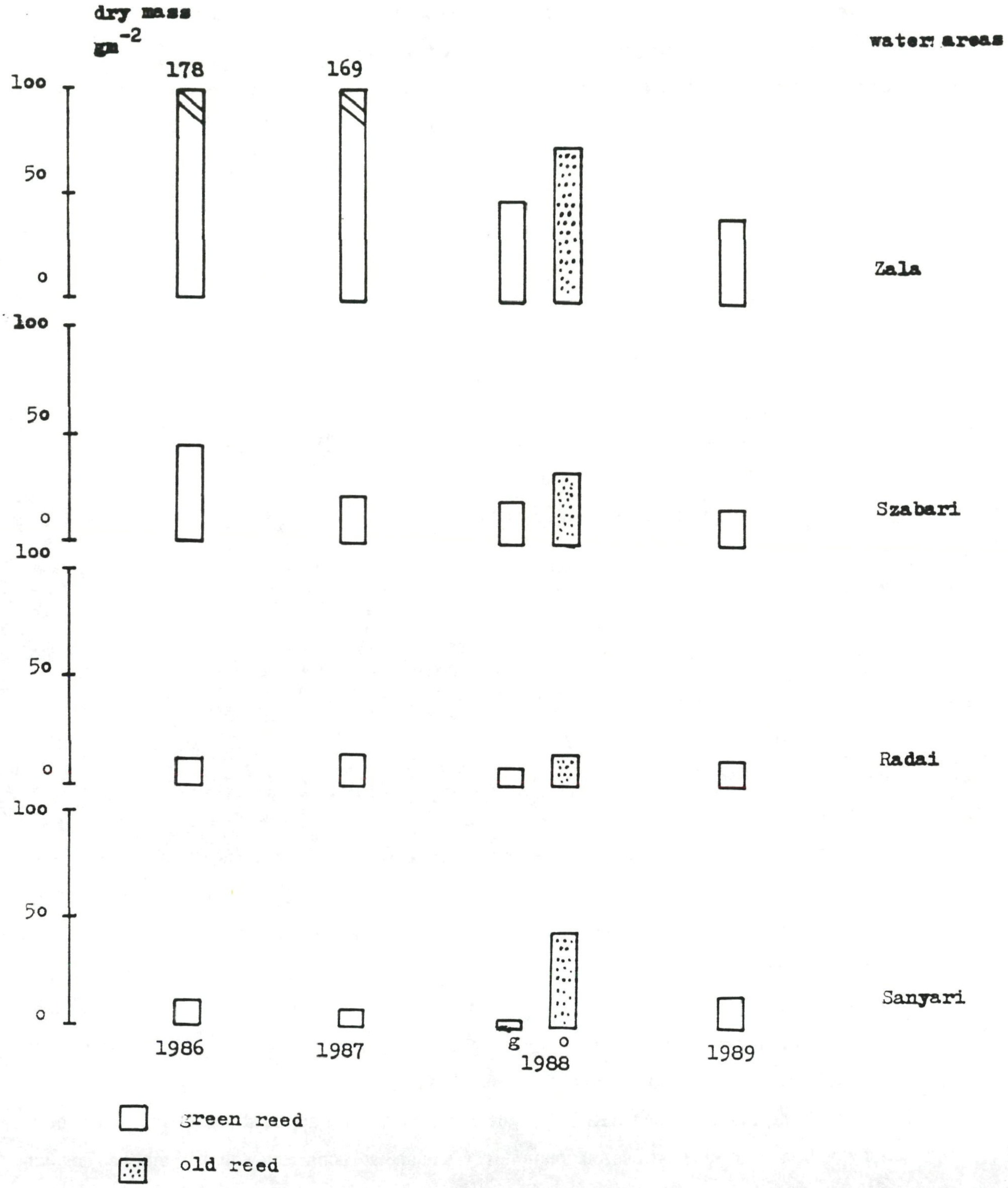

Fig. 2: Temporal and spatial changes in dry mass of reed-preiphyton

The larger part of periphyton is formed by the inorganic component. The ash content seemed to be a useful parameter for the characterization of the inorganic fraction (Table 2).

Table 2: Basic categories of periphyton on the basis of ash content for the classification of water areas

		Ash %
I.	inorganic periphyton type	75
II.	inorganic-organic periphyton type	50-75
III.	organic-inorganic periphyton type	25-50
IV.	organic periphyton type	25

categories

	reed-periphyton		*Polygonum*-periphyton	
I.	Z,B	(2)	Z	(1)
II.	Sz, P, Ka	(3)	B,Sz, P, Ka	(4)
III.	R, G, M, K	(4)	R, G, M	(3)
IV.	S	(1)	S	(1)
		10		9

The inorganic periphyton category is characteristic only for River Zala. The upper water regions of the system e.g. Szabari and Pogányvár areas and the Kazetta can be classified into the second category. It has been found that only the Sanyari water region, the effluent of the protecting systems can be described by the organic periphyton category, this is an indirect evidence for the mechanical sedimentating effect and biofilter function of the system.

Considering the chlorophyll a content the periphyton of green reed samples with the exception of three water areas belongs to the hetero-autotrophic type (Table 3).

Table 3: Types of periphyton on the basis of Chlorophyll a concentration

		Chlorophyll a %
I.	autotrophic periphyton type	0,6
II.	auto-heterotrophic periphyton type	0,25-0,6
III.	hetero-autotrophic periphyton type	0,1-0,25
IV.	heterotrophic periphyton type	0,1

type

	reed periphyton		*Polygonum* periphyton	
I.		(0)		(0)
II.	G, M, S	(3)	S	(1)
III.	Z, B, Sz, P, R, K, Ka	(7)	Z, B, Sz, P, R, Ka	(6)
IV.		(0)	G, M	(2)

In case of *Polygonum* the situation changes a little bit: only the Szabari water area can be described by a auto-heterotrophic periphyton type while in the Garabonci and Magyaródi water areas the periphyton is of heterotrophic type due to the significant sedimentation of organic materials and the great number of zoo-organisms. The N and P content of periphyton are different in water regions which can be explained partly by the load of plant nutrients and partly by physical-chemical processes (Table 4).

Table 4: Nitrogen, phosphorus content and N/P ratio of periphyton in some water areas of system (summer 1986)

	N	P %	N/P
Zala (Z)	2,416	0,481	5,0
Szabari (Sz)	3,582	0,398	9,7
Radai (R)	3,945	0,386	10,2
Sanyari (s)	2,778	0,275	10,1

In River Zala the periphyton has a low N content and high P content and as a consequence of it the N/P ratio is only five. In the Szabari and Radai water regions beside the relatively high N and P concentrations the N/P ratio amounts to ten.

In accordance with the purification gradient low N and P contents are characteristic of the periphyton in the Sanyari water area which are connected with the result of water chemistry.

Table 5 demonstrates the concentration order of elements in the periphyton and the host plants.

Table 5: Concentration order of elements in periphyton and its host plants

Phragmites-periphyton:	Ca Fe Mg K Mn Na Zn
Phragmites:	K Ca Na Mg Fe Mn Zn
Typha-periphyton:	Ca Fe Mg Mn K Na Zn
Typha:	K Fe Ca Na Mg Mn Zn
Polygonum-periphyton:	Ca Fe Mg K Mn Na Zn
Polygonum:	Ca K Mg Fe Na Mn Zn

The three types of periphyton differ only in the concentration of potassium and manganese while the element composition of the host plants differ more significantly. The concentration of zink is always low (Crossey & La Point 1988, Colwell et al. 1989). In the periphyton the concentration of calcium is the highest and its changes depend on the degree of incrustation. Similarly to other authors (Brown & Austin 1973, Eminson 1978, Pdisák 1982, Ross 1979, Uherkovich 1979) who study the periphyton on natural substrates we have also found that the diatoms and green algae occur with a great number of species and individuals in the periphyton of reed, knotweed and bulrush (Table 6).

Table 6: Percentage distribution of phyla in phytotecton (1986 summer)

	reed	knot-weed phytotecton	bulrush
		%	
Cyanophyta	12,2	10,5	8,1
Euglenophyta	5,5	11,6	0,0
Bacillariophycea	53,3	43,0	51,4
Chlorophyta	28,9	34,9	40,5
	(100)	(100)	(100)
number of species	90	86	37

The number of taxa is similar in the periphyton of reed and *Poligonum* but it is smaller in the periphyton of bulrush as a consequence of the small number of samples. In the phytotecton of each aquatic plant two diatomic algal species, *Achnanthes minutissima* and *Cocconeis placentula* can be observed with a great number of individuals. The faunistical results of zootecton study are considered because the results are very characteristic for different water regions of the protecting systems (Table 7).

Table 7: Faunistical results of zootecton analysis

	Z	Sz	R	S
Hydrozoa				+
Nematoda	+	+	+	+
Rotatoria	+	+	+	+
Oligochaeta	+			
Hirudinoidea	+			
Bryozoa		+	+	+
Trichoptera				+
Chironomidae	+	+	+	+

Hydra and Trichoptera species could be found solely in the periphyton of the Sanyari sampling sites, while the presence of Oligochaeta and Hirudineae species could be observed only in River Zala. Except the latter site *Plumatella fungosa*, a Bryozoa species was abundant everywhere in the protecting systems, agreeing with the findings of Srensen et al. (1986). The community types of zootecton formed on reed and *Polygonum* are estabilished (Table 8).

Table 8: Types of zootecton community

1. Rhabditidae-Bdelloidea-Chironomidae	Z
2. Phylactolaemata-Bdelloidea-Trichoptera	S
3. Phylactolaemata-Bdelloidea-Chironomidae	B, Sz, P, R, G, M, K, Ka
4. Cladocera-Bdelloidea-Chironomidae	-

The zootecton samples taken from River Zala and the Sanyari water areas are different compared to the other sites (Fig. 3). The former samples can be classified into the Rhabditidae-Bdelloidea-Chironomidae zootecton type. The latter one can be described by Phylactolaemata-Bdelloidea-Trichoptera zootecton type. The remaining samples belong to the Phylactolaemata-Bdelloidea-Chironomidae type, which is characteristic of Lake Fertö too (Lakatos 1989a). The mass of periphyton differs considerably in the various water areas of Kis-Balaton Protecting Sytem (Table 9).

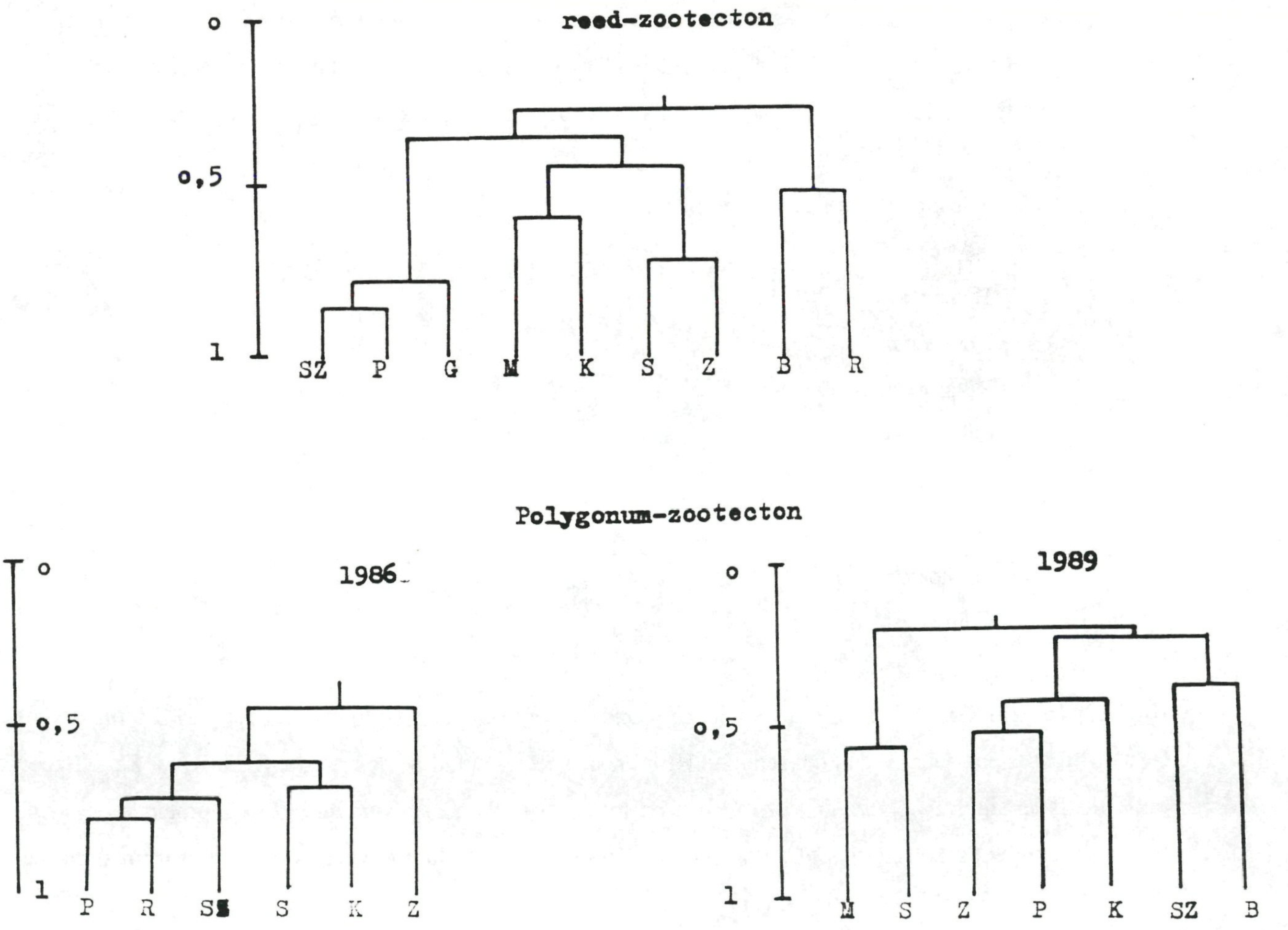

Fig. 3: Dendrograms of zootecton (Csekanowski index)

Table 9: Classification of periphyton in Kis-Balaton Protecting System

	categories of periphyton dry weight		
types of periphyton	large I.	medium II.	small III.
autotrophic I.			
auto-heterotropic II.		M	G, S S
hetero-autotrophic III.	Z, B, Ka Z, B, Sz, Ka	Sz P, R	P, R, K
heterotrophic IV.			G, M

reed-periphyton Z
Polygonum-periphyton Z

In River Zala and in the upper water areas the periphyton can be described by a large mass category and can be classified into the hetero-autotrophic type. In the lower part of the system close to the effluent the periphyton has a small biomass and belongs to auto-heterotrophic type. The chemical and biological parameters of the periphyton on reed and knot-weed indicate an oligotrophication process in the system. The organisms of phytotecton and zootecton provide an important food for fish (Power et al. 1985, 1989), thereby they take part in the natural biological purification and the improvement of water quality of Kis-Balaton Protecting System.

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