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Study on chemical composition of reed-periphyton in Lake Balaton

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Abstract: In our time the waters are endangered by eutrophication and Lake Balaton is no exception. During the course of research on the littoral zone of this lake we have studied the periphyton forming on reeds in three transects of reedbeds in the bays at Keszthely, Palonznak and Bozsa. The aim of this paper is to compaire the chemical composition of reed-periphyton in two years of investigation. The mass, ash, N and P content of periphyton are different in 1979 and in 1989, which can be explained partly by a decreasing load of plant nurtrients, due to the role of the reconstructed Kis-Balaton Protecting System, and partly by the physical-chemical processes. The organisms of periphyton provide an important food for fish, thereby they take part in the natural biological purification and improvement of the water quality of Lake Balaton.

Introduction

Nowadays our waters are endangered by eutrophication and Lake Balaton is no exception (Herodek & Tamás 1976, Biró & Vörös 1982, Lakatos et al. 1982, Padisák 1991, Vörös & Padisák 1991). In the fight against the eutrophication in the shallow water bodies the utilization of the macrovegetation especially the reed-stands in the littorol zone seem to be more and more important (Tóth 1972, Kovács 1978, Meulemans 1988, Lakatos 1989a, Wetzel 1989).

The submerged parts of reed are covered by periphyton, which has a very important effect on the water quality in shallow water bodies, therefore it is necessary to focus on its investigation (Wetzel 1960, Kowalczewsky 1965, Burkholder & Wetzel 1989).

During the course of research on the littoral zone of Lake Balaton we have studied the periphyton forming on reed in three transects of reed beds in the bays at Keszthely, Paloznak and Bazsa (Lakatos et al. 1982). The reed stands in the Bay of Keszthely are the most nutrient rich areas of the lake; in front of the reeds there is the community of bulhrush. The excessive eutrophication thus affected the reed stands negatively; through the deposition of highly sediments, and it can be reducing this reed population declined.

In a biological sense the reed stands in the Bay at Paloznak are perhaps the only relatively less disturbed ones in the littoral zone of present-day Lake Balaton. Near the bank the surface and body of water is covered by a dense community of aquatic plants (*Utricularia, Ceratophyllum, Hydrocharis, Potamogeton*). The *Fontinalis* zone of the reedbeed, which was very characteristic in 1979 ten years later has only a narrow belt in the middle of this reed zone. The edge of the reedbeed consists of small and weak stems of reed.

Human activity has left rather visible traces in the reed stands in the Bay of Bozsa. Due to silting up from the agricultural territory of this bay the water level significantly decreased and in the shallow water some marsh plants appeared and flowered (*Stratiotes Sium, Carex, Gallium, Scutellaria*) and we were not able to take periphyton samples.

Material and methods

The transects of the bays in both years and the sampling sites are illustrated in Fig. 1. The last year our sampling sites decreased in the bays at Keszthely and Bozsa due to the decline of the reedbed near the open water.

The periphyton samples were taken from green and old reed in July in both years; at the same time water and mud samples were taken too.

We measured wet and dry mass, the ash, Chlorophyll-a, N and P contents were determined. We calculated the N/P ratio and the so-called autotrophic index expressing the relation between the content of organic matter and Chlorophyll-a content. The cation contents were also determined from the periphyton and the water samples and we calculated the concentration factor.

The classification system of reed-periphyton which was developed on the basis of our studies on the Pannon shallow lakes was applied (Lakatos 1983, Lakatos 1989b).

Results and discussion

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

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	1979	1989
I.		Ko
II.	Ko Bo	Kb, Km,
III.	Kb, Km Bb, Bm, Bo Pb, Pm, Po	Bb, Bm Pb, Pm, Po

b= near the bank
m= in the middle
o= near the open water

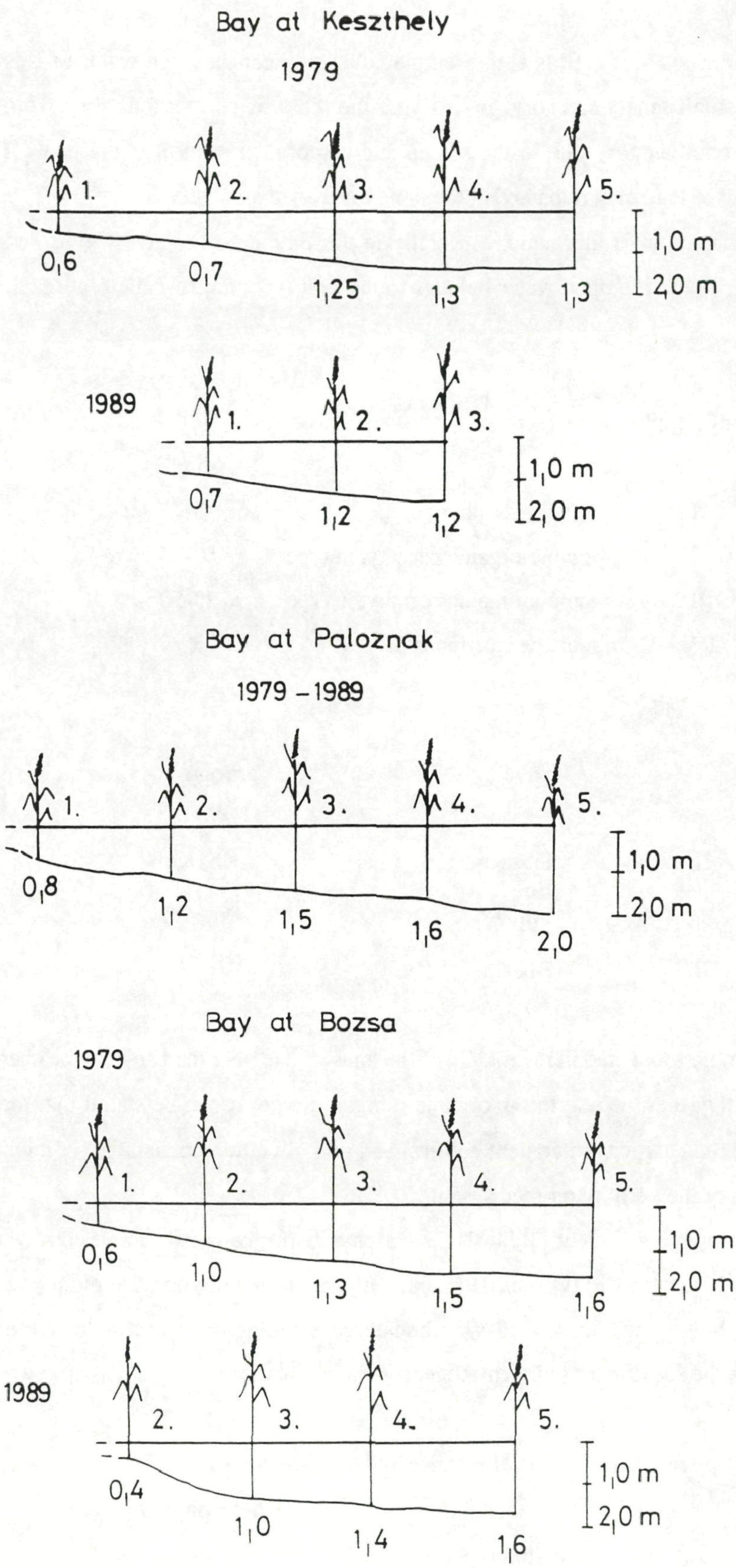

Fig. 1: Sampling sites (1979-1989)

In 1979 the samples except of one (this is the sample collected near the open water of Keszthely Bay) belong to the third (small mass) category. In last year the mass of periphyton taken from the Bay of Keszthely increased one category due to the silt up and disposal of mud near the bank. The samples collected from the Bay of Paloznak remained in the same category than earlier.

The larger part of periphyton is inorganic, especially in the Bay at Keszthely. The ash content of the sample (Table 2) taken near the open water belongs to the first type, the so-called inorganic periphyton type.

Table 2: Ash content of periphyton on reed

		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

periphyton types

	1979	1989
I.		Ko
II.	Kb, Km, Ko Bo Pm, Po	Kb, Km Bo Pm, Po
III.	Bb, Bm	

Ten years ago the samples collected in the middle of the transect and near the bank can be characterized by organic type, presentley they belong to the organic-inorganic type. It can be stated that the increase in periphyton mass and their larger ash content confirm and underline the mechanical sedimentating effect and biofilter function of the periphyton-reed system.

Considering the Chlorophyll a content (Table 3) the periphyton of green reed samples can be classified as autotrophic and auto-heterotrophic types in 1979 but ten years later only one sample remain in the first type, most of them belong to the second type and three samples can be characterized with small Chlorophyll a, due to the significant sedimentation of organic material.

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

		Chlorophyll a (%)
I.	autotrophic periphyton type	0,60
II.	auto-heterotrophic periphyton type	0,25-0,60
III.	hetero-autotrophic periphyton type	0,10-0,25
IV.	heterotrophic periphyton type	0,10

periphyton types

	1979	1989
I.	Kb Pm Bb	Bb
II.	Km, Ko Bm, Bo Pb, Po	Kb, Km Bm, Bo Pb
III.		Ko Pm, Po
IV.		

The changes in the Chlorophyll-a content is an indication of the altered water quality condition.

The N and P content of periphyton are different in 1979 and in 1989, which can be partly explained by the load of plant nutrients - we think due to the role of the reconstructed Kis-Balaton Protecting System - and partly by the physical-chemical processes (Fig. 2). The periphyton samples taken in 1989 have lower N and P content than they had ten years ago, when large N and P concentrations were characteristic of the periphyton in the Bay at Keszthely and moderate N and slight P in the Bay at Bazsa.

The values are smaller in case of periphyton collected from old reed due to the higher ash content in both years.

In Fig. 3 the relationships between AI and N/P ratio are illustrated for green and old reed. The peri-phyton samples collected in the two years are distinguished. The samples taken in different bays form three groups proved by their altered conditions.

Based on the mass and Chlorophyll a content of periphyton (Table 4) considerable changes become obvious in the bay at Keszthely and Paloznak.

Table 4: Classification of periphyton on the basis of its dry mass and Chlorophyll a concentration

types	categories 1979			categories 1989		
	I.	II.	III.	I.	II.	III.
I.			Kb Bb Pm			Bb
II.		Ko	Km BM, Bo Pb, Po		Kb, Km Bo	Pb BM
III.				Ko		Pm, Po
IV.						

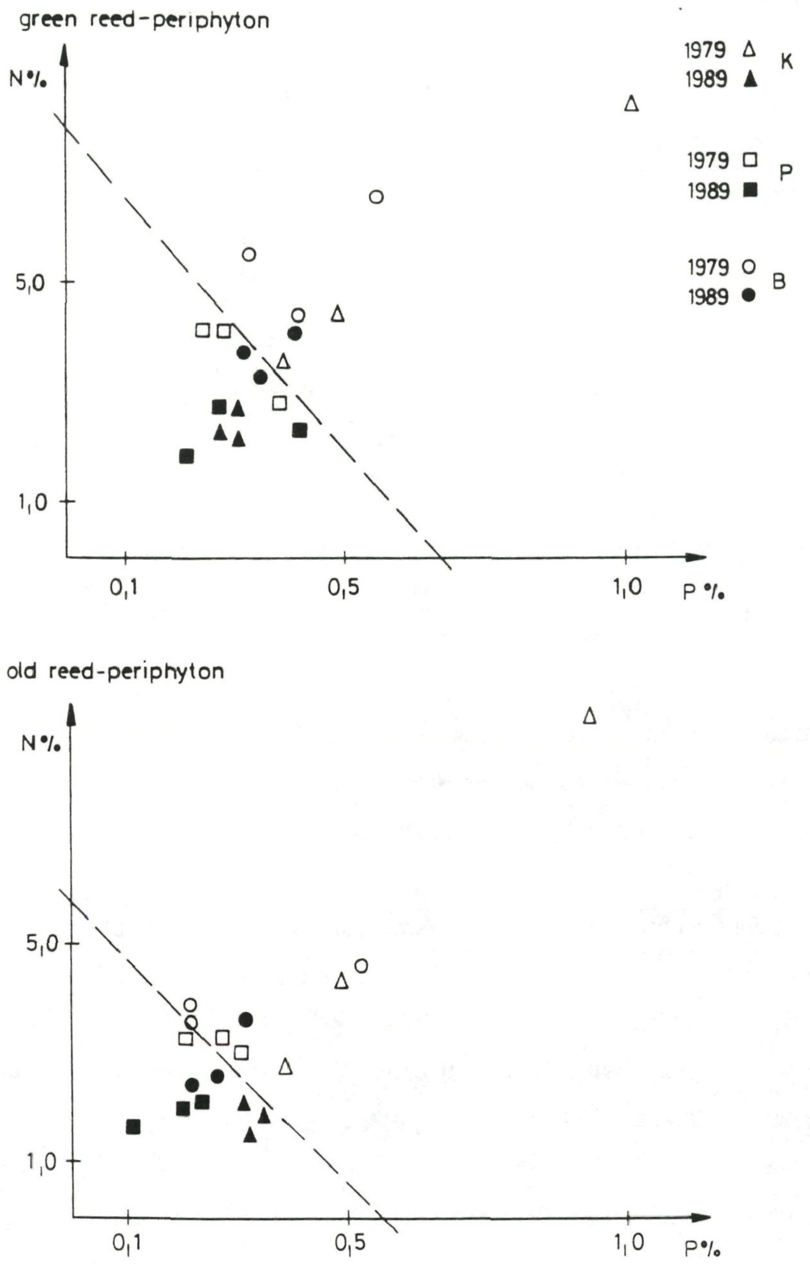

Fig. 2: Relationship between N % and P %

The periphyton samples taken near the edge of the reed bed at Keszthely can be described by large mass category and can be classified into the hetero-autotrophic type. The chemical parameters of the periphyton on reed indicate a sedimentation and biofiltration process in the reed bed.

The concentration factors of the elements (Table 5) reflect the role of periphyton, that is the complex plays a role in buffering influences coming from the bank, in taking up and accumulation of micro-elements.

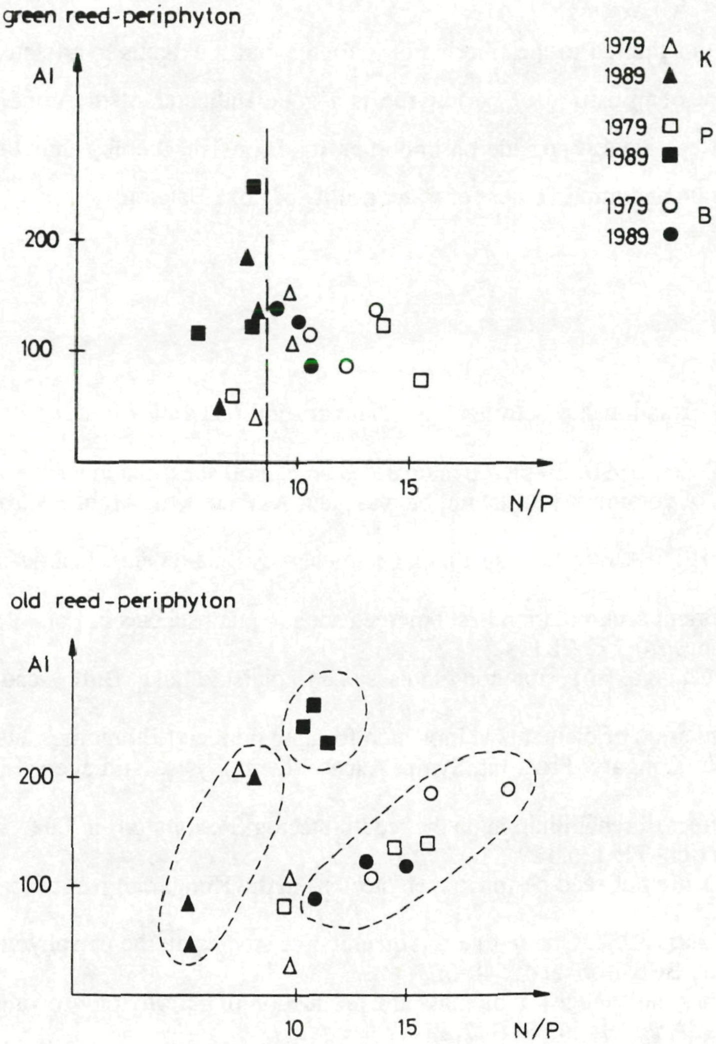

Fig. 3: Relationship between Al and N/P ratio

Table 5: The concentration factors of the elements

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1979

N $x10^5$	P $x10^4$
Na $x10^2$	K $x10^3$
Ca $x10^3$	Mg $x10^3$
Fe $x10^4$	Mn $x10^4$
Cu $x10^4$	Zn $x10^4$

1989

	Keszthely	Bozsa	Paloznak
N $x10^4$	2,3	9,3	3,3
P $x10^4$	3,6	26,0	4,0
Na$x10^2$	4,7	2,7	2,0
K $x10^3$	1,1	0,7	0,9
Ca$x10^3$	2,9	2,9	1,6
Mg$x10^2$	2,3	2,4	4,5

The role of periphyton is not limited to the filtering of nutrients, but it extends to an active processing. Furthermore, the chemical composition of periphyton is a good indicater of the condition of water quality. The organisms of periphyton provide on important food for fish, thereby they take part in the natural biological purification and improvement of water quality of Lake Balaton.

References

Birö, P. & L. Vörös, 1978. Relationship between phytoplankton and fish yields in Lake Balaton. Hidrobiologia 97: 3-7.

Burkholder, J.A. &R.G. Wetzel, 1990. Epiphytic microalgae on natural substrata in a hardwater lake: Seasonal dynamics of community structure, biomass and ATP content. Arch. Hydrobiol. Suppl. 83: 1-56.

Herodek, A. & G. Tamás, 1976. A fitoplankton tömege, termelése és Balaton eutrofizálódása. Hidrol. Közl. 56: 219-228.

Kovács, M., 1978. The element accumulation in submerged aquatic plant species in Lake Balaton. Acta Bot. Acad. Sci. Hung. 24: 272-283.

Kowalczewski, A., 1965. Changes in periphyton biomass of Mikolaiskie Lake. Bull. Acad. Pol. Sc. 13: 395-398.

Lakatos, G., 1983. Accumulation of elements in biotecton forming on reed (Phragmites austyralis) in two shallow lakes in Hungary. Proc. Int. Symp. Aquat. Macrophytes, Nijmegen, 18-23. September: 117-122.

Lakatos, G., 1989a. The effect of rehabilitation on the reed-biotecton (Periphyton) in Lake Velencei (Hungary), BFB-Bericht 71: 135-139.

Lakatos, G. 1989b. Composition of reed periphyton (biotecton) in the Hungarian part of Lake Fertö. BFB-Bericht 71: 125-134.

Lakatos, G., L. Vörös, B. Entz, 1982. Qualitative and quantitative studies on the periphyton (bitecton) of reed in Lake Balaton. BFB-Bericht 43: 40-61.

Meulemans, J.T., 1988. Seasonal changes in biomass and production of periphyton growing upon reed in Lake Maarsseveen I. Arch. Hydrobio. 112: 21-42.

Padisák, J., 1991. Relative frequency, seasonal pattern and possible role of species rare in phytoplankton in large shallow lake (Lake Balaton, Hungary). Verh. Internat. Verein. Limnol. 24: 989-992.

Toth, L. 1972. Reeds control eutrophication of Balaton Lake. Water Res. 6: 1533-1539.

Vörös, L., and J. Padisák, 1991. Phytoplankton biomass and chlorophyll-a in some shallow lakes in central Europe. Hydrobiologia 215: 111-119.

Wetzel, R.G. 1960. Marl incrustation on hydrophytes in several Michigan lakes. Oikos 11: 223-236.

Wetzel, R. G., 1989. Land-water interfaces: Metabolic and limnological regulators. Verh. Internat. Verein. Limnol. 24: 6-24.