BFB-Bericht 71, 125 - 134
Biologisches Forschungsinstitut für Burgenland, Illmitz 1989

Composition of reed periphyton (biotecton) in the Hungarian part of lake Fertö

G. Lakatos

Ecological Institute of L. Kossuth University, H - 4010 Debrecen

Abstract: The reed-periphyton samples collected in the Hungarian part of lake Fertö were classified into the categories established on the basis of the dry mass and organic chemical components. The samples collected from outer water area belong to the medium mass and heterotrophic type. The transitional area can be classified into medium mass and hetero-autotrophic type together with the southern area of the Austrian part. The periphyton of the reed-belt can be described as a specific type, i.e. the periphyton of small mass and hetero-autotrophic type. The periphyton of small mass and auto-heterotrophic type is characteristic of the inner lakes of Fertö.

Kurzfassung: Schilf-Periphyton-Proben vom ungarischen Teil des Neusiedler Sees werden Kategorien zugeteilt, die auf Menge an Trockenmasse und chemischer Zusammensetzung basieren. Periphyton von Schilf, das dem offenen See zugewandt ist, entspricht dem mittlere Trockenmasse-heterotrophen-Typus. Solches aus Übergangszonen und dem österreichischen Südteil des Sees entsprechen dem mittlere Trockenmasse-hetero-autotrophen Typus. Ein spezieller Periphytontypus tritt im Schilfgürtel auf: geringe Trockenmasse-hetero-autotroph. Die offenen Wasserflächen im Schilfgürtel zeigen Periphyton vom geringen Trockenmasse-auto-heterotrophen Typus.

Introduction

The reed belt plays an important role within the ecosystem of a shallow lake. The submerged parts of reed-stands are covered by periphyton (Wetzel, 1960; Kowalczewsky, 1965; Lakatos et al. 1982; Meulemans, 1988). Since years the significance of the reed belt and its periphyton has been recognized (Szczepanska, 1970; Lakatos, 1983; Meulemans & Heinis,1983; Meulemans, 1988) but only some papers studied it in detail, especially in the case of Lake Fertö (Sommer, 1977; Padisak, 1982; Lakatos & Hammer, 1986).

Three years ago we reported about the results obtained during the periphyton investigations in the Austrian part of the lake (Lakatos & Hammer, 1986), since then only sporadic studies were performed in the Hungarian part of the lake.

For this reason we started reed-periphyton investigations in the Hungarian part of Lake Fertö in 1988. The main aim of the study was to reveal and compare the composition of periphyton in areas of the Hungarian Fertö of different water quality during the summer period.

Material and methods

The sampling sites are illustrated in Fig. 1. The selected 14 sampling stations are located in areas of different water quality (Takács, 1984), i.e. the outer water area, the transitional water area, the inner lakes and the reed belt. The Homoki-, the Rucás, the Homokköi- and the Madárvárta bays belong to the outer water area of the southern part of the open water area of Lake Fertö; here the water colour is grey.

The transitional areas involve the Fertörákosi - lake, the Püspöki-, the Kladler and the Herlakni lakes. The latter is connected to the others with a narrow channel. In this area the water colour is greyish-brown and depends considerably on the direction of wind.

Among the inner lakes samples were taken in the Hidegségi-, the Átjáró-, the Oberlakni - and Kisoberlakni lakes. In these lakes the water colour is brownish-black.

Inside the reed belt the sampling was performed at the two permanent sampling locations of the Hungarian Research Station.

Fig.2 illustrates the sketch of reed (*Phragmites australis*) and the samples which were analyzed. At the same time water samples were taken and water depth and transparency were measured. Wet and dry mass as well as the ash content of the periphyton were determined. The Chlorophyll a was extracted by methanol. The concentrations of nitrogen, phosporus and the more important cations in the periphyton samples were determined too. The so-called autotrophic index (AI) expressing the relation between the content of organic matter and the Chlorophyll a content was calculated.

The taxon-individual number diversity in zootecton was estimated by the Shannon-index. Cluster analysis was applied for evaluating the similarity of different sampling sites. In this paper the classification system of reed-periphyton which was developed on the basis of our studies on the Pannonian shallow lakes (Lakatos, 1983, 1988) was applied.

Results and discussion

The values of water depth, transparency, TSS and COD are presented in Fig. 3. High transparency values occur in the inner lakes and inside the reed belt where the values of TSS are considerably smaller than in the bays of the outer water area. The COD is strikingly large in the water samples of the inner lakes and the reed belt. It is an obvious consequence of high concentrations of dissolved humic substances (Takács, 1984). Considering the dry mass of periphyton the following groups of sampling sites can be distinguished (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	I.	II.	III.
a	4	1,2,3	
b	6	5,7,8	
c		10	9,1,1
d			13,14
	(2)	(7)	(5)

The samples taken from the outer and the transitional water areas belong to the second category, while samples from the inner lakes and the reed-belt represent the third category.
This distribution is partly similar to the Austrian part of the lake where in 1986 the reed-periphyton of medium mass was dominant (Lakatos & Hammer, 1987).
The average ash content of the periphyton on the old reed is slightly larger than that on the green reed. The high content is characteristic for the samples collected in the outer water area which is in good agreement with our earlier results obtained in the Austrian part of Lake Fertö (Lakatos & Hammer, 1986). In this respect the transitional water area and the reed-belt occupy an intermediate position, i.e. they can be characterized by an inorganic-organic periphyton type (Table 2).

Table 2: Ash content of periphyton on reed.

The average ash content on the green reed = 58.5 %
The average ash content on the old reed = 60.5 %

		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			
	I.	II.	III.	IV.
sampels				
a	1,2,3,4			
b		5,6,7,8		
c			9,10,11,12	
d		13,14		
	(4)	(6)	(4)	(0)

The ash content of periphyton samples taken in the inner lakes does not reach 50% and consequently it can be classified into the third group representing an organic-inorganic type.

The Chlorophyll a concentration is an important feature of periphyton because it may indicate the role of periphyton in matter circulation and energy flow of a water body (Table 3).

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			
	I.	II.	III.	IV.
samples				
a				1,2,3,4
b			7,8	5,6
c		9,10,11,12		
d			13,14	
	(0)	(4)	(4)	(6)

Applying these limits we can classify the samples from the outer water area into the heterotrophic type, i.e. they have the smallest Chlorophyll a content (0.073).

Samples from the inner lakes contain Chlorophyll a in the highest concentration (0.394) and can be classified into the second, the so-called auto-heterotrophic type. These can be characterized by the dominance of the phytotecton like in case of samples taken from the area of Mörbisch and Rust earlier (Lakatos & Hammer, 1986). The samples from the transitional water area and reed belt occupy an intermediate position and can be classified into the third type. There are great differences in the nitrogren content of samples (Fig.4). The nitrogen concentration is very low, smaller than 1 %, in case of samples collected in the outer water area.

A bit higher, but also a low N-centent is characteristic of the periphyton in the inner lakes which is very similar to the brown-water area of Lake Velencei (Lakatos, 1988).

Almost the same conclusions can be drawn if we consider the P content of periphyton. As a consequence of it well-separated groups become obvious on the basis of this figure.

Low N and P content of the reed periphyton is characteristic in the outer water area. The transitional area, as usual, can be found in an intermediate position, while high N and P content occur in the periphyton of the inner lakes and the reed belt. The autotrophic index is smaller in the latter periphyton samples but it is below 500 in every case.

Table 4 summarizes the concentration factors of elements for the periphyton, i.e. the ratio of the concentration in the periphyton, to that in the water. It can be stated that there is a 10 000-fold accumulation of N and P in the periphyton.

Table 4. Concentration factors

$$cf = \frac{\text{element content in periphyton}}{\text{element content in water}}$$

	N	P	Na	K	Cl	Mg
	[10^4]	[10^4]	[10]	[10]	[10^3]	[10^3]
a	1,7	2,6	0,7	5,6	3,3	3,0
b	11,0	6,8	1,0	6,7	4,0	2,5
c	6,8	5,6	1,5	3,8	1,9	1,9
d	4,5	3,0	9,7	4,6	0,8	0,7

The considerable accumulation can be explained by the function of the reed-periphyton complex (Lakatos et. al., 1982) and the adsorption process (Allen, 1971; Mickle & Wetzel, 1978; Vymazal, 1988); it is confirmed by the high degree of the Ca and Mg accumulation. These findings serve as an evidence of the biofilter function of the reed-periphyton.

Taking into consideration the zootecton community types, the periphyton samples originating from different water areas can be distinguished (Fig.5). As in the case of the grey water area of Lake Velencei, the Rhabditidae-Cladocera-Trichoptera-community type is mostly characteristic of sampling sites in the outer and the transitional water areas, with exception of the Herlakni Lake, which can be classified into the Phylactolaemata-Bdelloidea-Chironomidae type where *Plumatella* and *Spongilla* species can be found too. The samples of the reed belt can be classified into the Cladocera-Bdelloidea-Chironomidae community type. Obviously the taxon-individual number diversity values of zootecton are high in some periphyton samples from the transitional area and the inner lakes (Fig.6).

The similarity of periphyton sampling sites on the basis of the taxonomical composition of zootecton is generally low (Fig.7). In the dendrogram three interesting groups can be established. Similarly to the chemical analysis of water and periphyton, the composition of zootecton also indicates the different water quality areas in the Hungarian part of Lake Fertö.

Recommendation

It should be emphasized that the water bodies of the Hungarian Fertö, possessing a mosaic character, are still in natural condition at present and deserve to be strictly protected. For this reason the establishment of a common Austrian-Hungarian National Park can be regarded as a very important step forward since it may greatly contribute to the conservation of the hydrobiological floristic and faunistic values of Lake Fertö.

References

Allen, H.L., 1971: Primary productivity, chemoorganotrophy and nutritional interactions of epiphytic algae and bacteria on macrophytes in the littoral of a lake. Ecol. Monogr. 41: 97-127.

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 australis) in two shallow lakes in Hungary. Proc. Int. Symp. Aquat. Macrophytes, Nijmegen, 18-23. September, 117-122.

Lakatos, G., 1988: Pannon sekely tavak nadasainak elöbevonata I.Magyar Ökologus Kongresszus, Budapest, 1988. aprilis 27-29. 108.

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

Lakatos, G. and L. Hammer, 1986: Preliminary results of epiphytic biotecton (periphyton) investigations in the Austrian part of Lake Neusiedl. (in press).

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

Meulemans, J.T. and F. Heinis, 1983: Biomass and production of periphyton attached to dead reeed stems in Lake Maarsseveen. In: Wetzel, R.G. (ed.). Periphyton of freshwater ecosystems. Development in Hydrobiology, 17, 169-173.

Mickle, A.M. and R.G. Wetzel, 1979: Effectiveness of submersed angiosperm-epiphyte complexes on exchange of nutrients and organic carbon in littoral systems. III.Refractory organic carbon. Aquatic Bot. 6, 339-355.

Padisák, J., 1982: The periphyton of Lake Fertö: species composition and Chlorophyll-a content. BFB-Bericht 43, 95-105.

Ross, P.J., 1983: Seasonal changes in diatom-structure of periphyton from two localities in Lake Maarsseveen: community index. In: Wetzel, R.G. (ed.), Periphyton of freshwater cosystems. Develompents in Hydrobiology 17, 59-61.

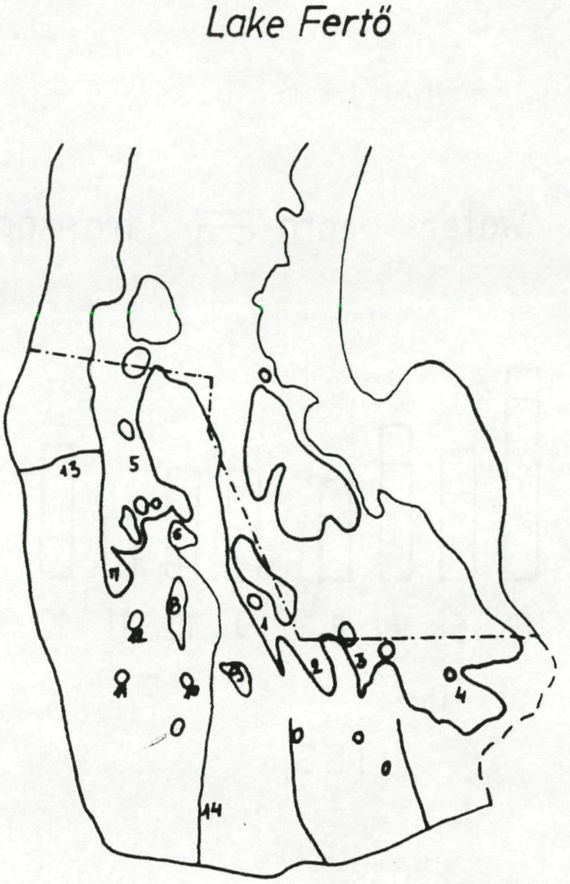
Sommer, U., 1977: Produktionsanalysen am Periphyton im Schilfgürtel des Neusiedler Sees. Sitzber. Österr.Akad.Wiss.Math.,-naturw. Kl. Abt.I, 186, 219-246.

Szczepanska, W., 1970: Periphyton of several lakes of the Mazurian lakeland. Pol.Arch.Hydrobiol. 17, 397-418.

Takács, T., 1984: About the inner ponds of the Fertö-lake. BFB-Bericht, 51, 31-36.

Vymazal, J, 1988: The use of periphyton communities for nutrient removal from polluted streams. Hydrobiologia 166, 225-237.

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



outer water-area	transition water-area	inner lakes	reed belt
1 Hb	5 Fr	9 Hi	13 Rb_1
2 Rb	6 Pü	10 At	14 Rb_2
3 HKb	7 Ke	11 Ol	
4 Mb	8 He	12 Kh	

Fig. 1: Sampling sites 7.7.1988

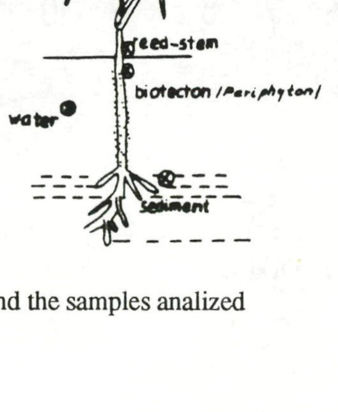


Fig. 2: Sketch of reed and the samples analized

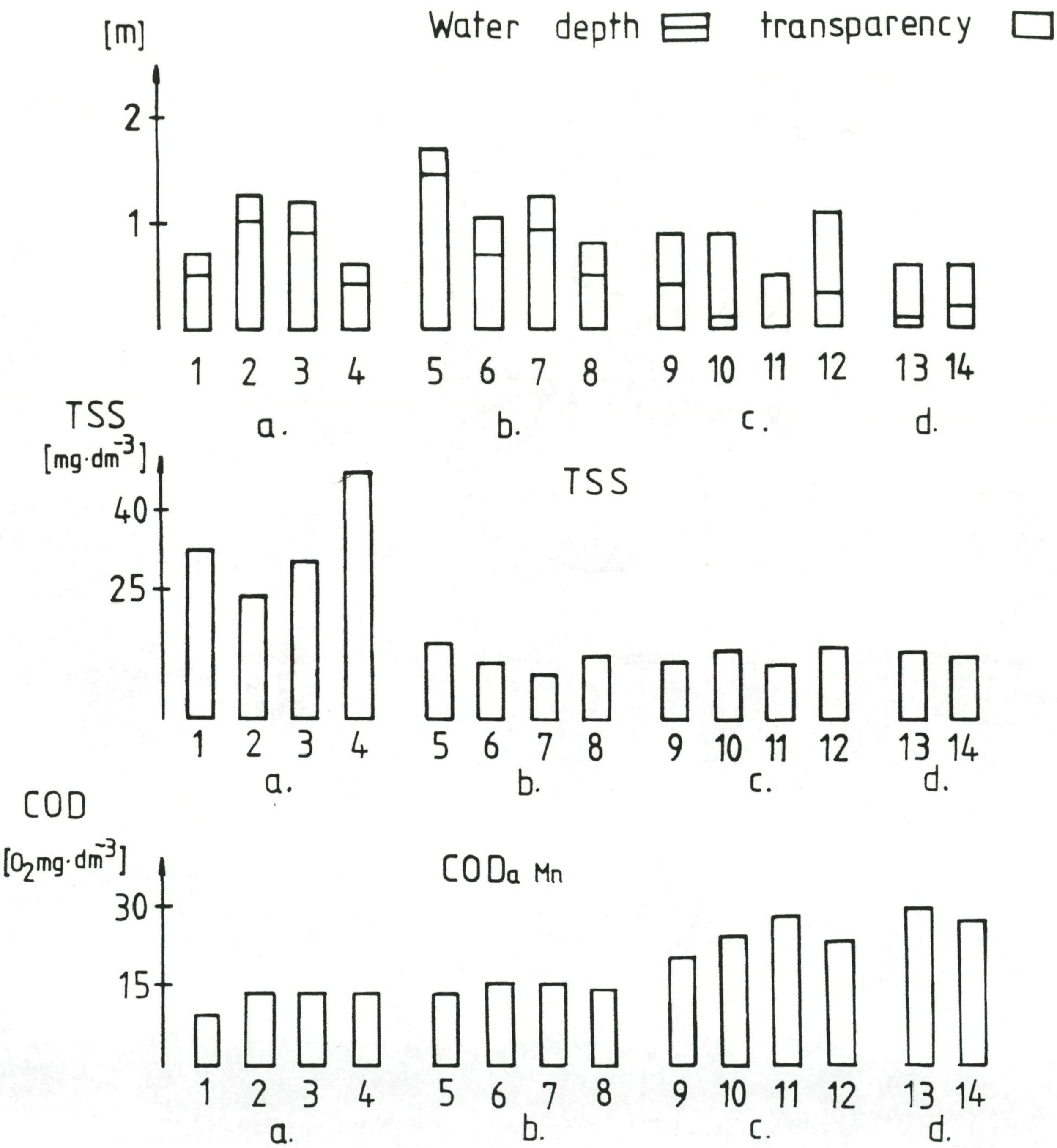


Fig. 3: Values of water depth, transparency, TSS and $CODa_{Mn}$

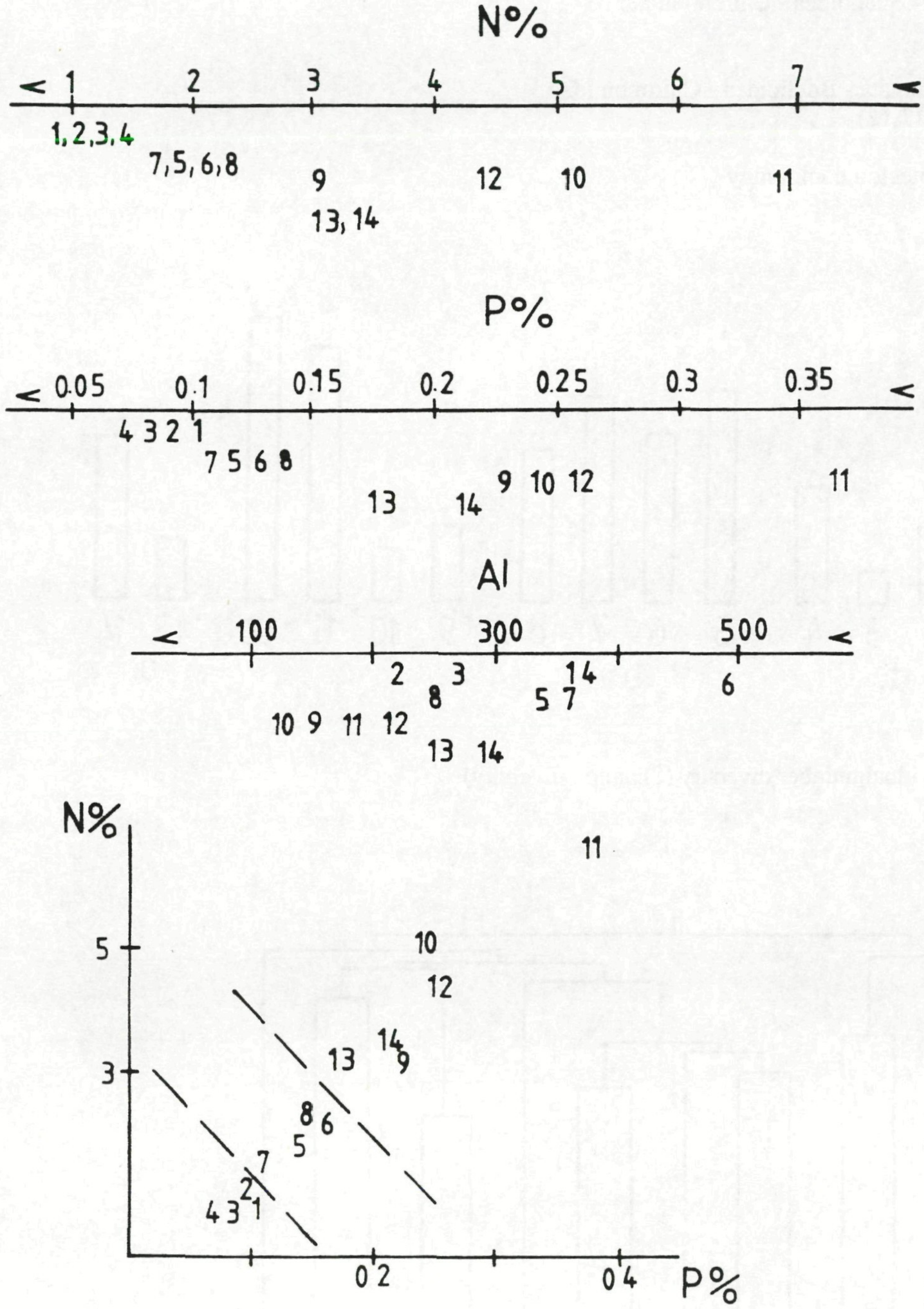


Fig. 4: N %, P % and Al values and the relationship between N % and P %

1. Rhabditidae - Cladocera -T richoptera
   (1, 2, 3, 4)   (5, 6, 7)

2. Phylactolaemata - Bdelloidea - Heteroptera

3. Cladocera - Bdelloidea - Chironomidae
   (13, 14)

4. Phylactolaemata - Bdelloidea - Chironomidae
   (8,9,10,11,12)

Fig. 5: Types of zootecton community

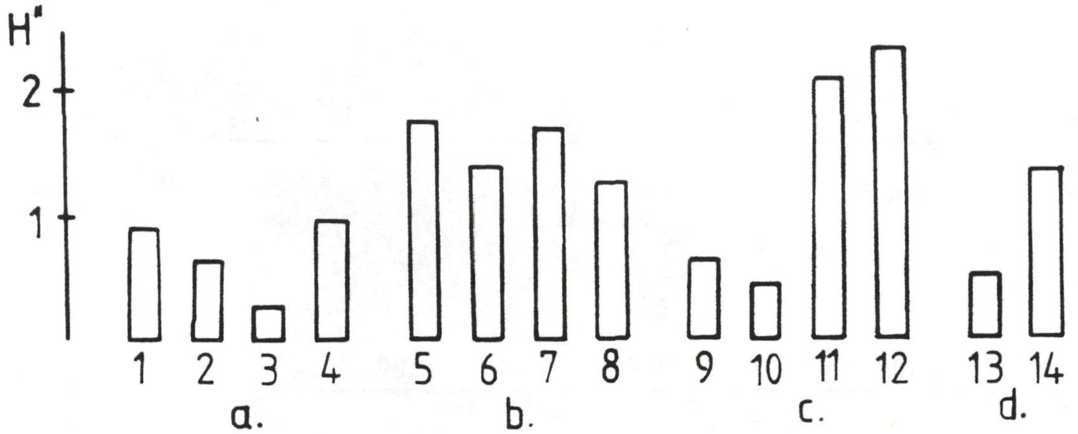


Fig. 6: Taxon - individual number diversity (Shannon diversity)

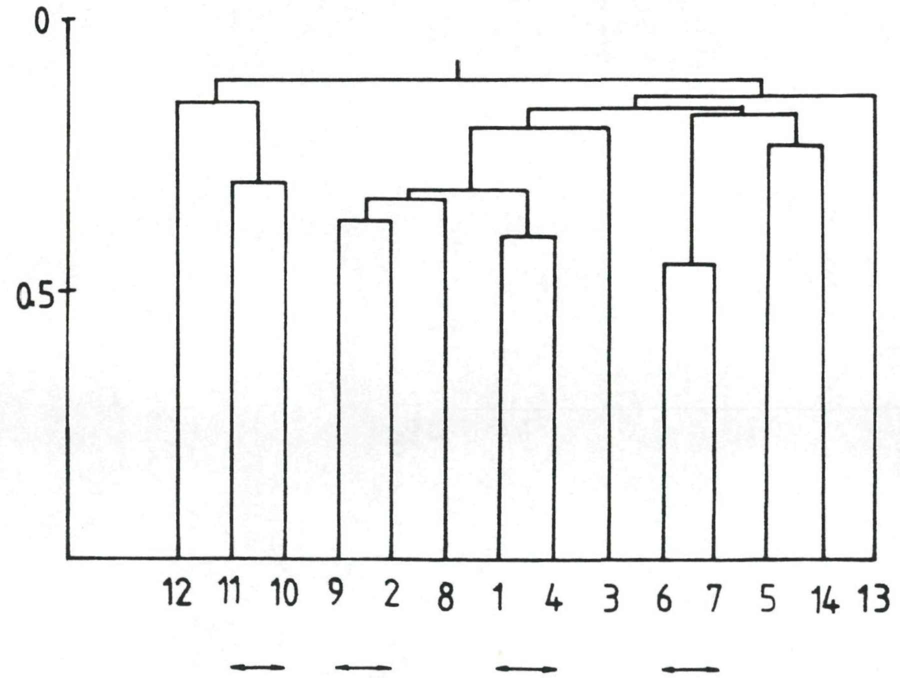


Fig. 7: Dendrogram of Zootecton