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THE PERIPHYTON OF LAKE FERTÖ: SPECIES COMPOSITION AND CHLOROPHYLL-A-CONTENT

Introduction

Algological studies in the Hungarian part of Lake Fertö were this year extended to cover the periphyton as well. As it is generally known, the reed-belt of Lake Fertö is very extensive, especially on the Hungarian side. Therefore, in any floristical and ecological study the periphyton of the lake must receive primary attention. Nevertheless, mainly due to methodological difficulties, studies on the periphyton are far behind those on the plankton all over the world. This lack of knowledge is expecially accute for the practical aspects of the problem, when, e.g., seeking answer to the role of the reed-belt and the periphyton in self-purification only rough estimates can be given.

We sought answer to the following questions in the course of our summer studies:

1) What are the species of algae found in the periphyton?
2) What are the dominance properties of the periphyton?
3) What kind of periphyton communities can be differentiated?
4) What is the abundance of periphyton?
5) Are there any floristical or numerical differences between the periphyton of the various macrophyton vegetations?
6) Are there any floristical or numerical differences in the periphyton from different localities?
7) Which of the two, the collecting locality, or the substrate vegetation has more influence over the species composition and abundance of the periphyton?

Methods

Samples of periphyton were collected between 14 and 18 July from stands of Phragmites communis, Typha angustifolia, Schoenoplectus litoralis and Potamogeton pectinatus. The collecting localities are shown in Fig. 1. In the case of Phragmites, Typha and Schoenoplectus, the abovewater parts were cut off. Then a tube with an inner diameter of 1,6 cm was pulled over the underwater stump, which was severed 10-16 cm below the surface. The lower end of the tube was then closed and the section of stem thus transferred to a collecting jar, which was kept in darkness during transportation. The periphyton was thorouhgly washed from the section of the stem, the surface of which was calculated from its length and diameter. Pieces of Potamogeton pectinatus were collected without the use of glass tubes, simply by putting them in the collecting jar, taking care not to include intersticial water as well. Measurements of the breadth of the stem and leaf of Potamogeton pectinatus showed that it was invariably 0,8 cm, so multiplying this value by the measurements of the length of the piece, the area of the surface of stems and leafs were obtained. Sample sizes from each locality and plant species are given in Table 3.
The periphyton cleaned from the macrophyton were strained on a GF/C glass filter and after solving in methanol, chlorophyll-a content was determined by spectrophotometry. The results are given as μg chlorophyll-a. cm^{-2} surface of macrophyton. Extinction was also measured at 480 nm, and from the formula

$PER = \frac{E_{480}}{E_{666}}$, the Pigment Extinction Rate (MARGALEF 1960, 1965, WINNER 1972, HAJDU et al. 1980) was calculated.

One piece of macrophyton from each locality together with its periphyton were fixed in formaldehyde solution, from which the species were identified. The cell content of the diatoms was dissolved in H_2O_2 as described in HORVATH (1975). Several identification manuals (BARTHA et al. 1976, BOURRELLY 1966, 1968, 1970, FELFÖLDY 1972, 1981, HINDAK et al. 1973, HUBER PESTALOZZI 1938-1961, HUSTEDT 1930, NEMETH 1980) and other publications (HUSTEDT 1959 a, 1959 b, 1959 c, KUSEL-FETZMANN 1974, 1979 a, 1979 b, PANTOCSEK 1912) were used during identification. The data were analiysed with help of basic statistical tests and cluster analysis using JACCARD`S measure of similarity (JACCARD 1908) and UPGMA fusion algorithm (SNEATH AND SOKAL 1973).

Results and discussion

The 7 periphyton samples studied contained 214 species and subspecific taxa of algae. A list of the species and their occurrance is given in Table 1. Most of the species which are here first recorded are blue-green algae. These new records will be discussed elsewhere. Table 2. is a summary of the floristical results. Blue-green algae occurred in negligible abundance and number ob species in the Rǎkosi Bay, which is the area on the Hungarian side more or less like the open water on the Austrian side.
The number of species increased towards the reed-belt, and it was the highest at the most southernly collecting locality. Xanthophyceae algae occurred in brown waters only. At the same time, the abundance of diatoms, except for spots of Schoenoplectus litoralis, was the highest in periphyton samples from Rakosi Bay. The number of species of green algae was strikingly high on stands of Potamogeton pectinatus in brown waters. It is remarkable that in samples from various plants but from the same locality, the pooled number of species was similar. Thus, in the Rakosi Bay, neighbouring stands of Phragmites, Typha and Potamogeton had numbers of periphytous algal species of 79, 84 und 82. In the Herrenlacken neighbouring stands of Phragmites and Typha contained 68 and 76 species, respectively. The number of species was lower on Schoenoplectus litoralis in the open water of Rakosi Bay (55), and much higher in Potamogeton pectinatus of the other lake with brown water, the Atjǎrő lake (112). The above mentioned data were subjected to cluster analysis (Fig. 2). Two similar groups can be seen on the dendrogram. One includes the samples of Rǎkosi Bay, the other group is made up of samples from brown waters. This phenetic grouping shows that the species composition of the periphyton is determined by the surrounding environment, rather than by the substrate vegetation.

Microscopic appearence of the periphyton from the Râkosi Bay showed the dominance of diatoms not only as regards the number of species, but also as regards abundance. The structural frame of periphyton there was made up of mucous and nonmucous diatoms (Rhoicosphaenia, Gomphonema, Cymbella). It is this layer that the similarity abundant Bacillaria were embedded in. Besides these, Nitzschia were common on Phragmites, and Cocconeis on Potamogeton. On all three species of plants, the periphyton was loosely attached to the substrate.

The periphyton of Schoenoplectus litoralis stands in the Rákosi Bay was stronghly attached, uneven and mucous, caused by large colonies of Gomphonema olivaceum interspersed with Diatoma elongatum, The dominant species in the periphyton of the previous locality, Rhoicosphaenia and Bacillaria, occurred here in negligible numbers only. Especially the latter, but the three other periphyton samples from the Rákosi Bay were full of inorganic sestonic particles.

Cymbella, Gomphonema, Spirulina and Oscillatoria were common in stands of both Phragmites and Typha in the Herrenlacken.

Achnanthes and Spirogyra were also found in large numbers on Typha. Both periphyton was strongly attached to the substrate plant, on the Phragmites being bark-like, on the Typha rather fluffly because of the filaments of Spirogyra.

The layer on Potemogeton pectinatus in the Atjârô lake was loosely attached to the plant with abundant Cymbella and Oscillatoria and many other species of algae evenly distributed in numbers.

Details of the results of the studies on the chlorophyll-a content and pigment extinction rates are given in Table 3. It may be seen in first sight that the dispersion of the chlorophyll-a data is very large. This is not so much due to the small sample sizes (except the Typha data from Herrenlacken), but rather due to the great variability in abundance of the periphyton on each plant. To illustrate this, 21 chlorophyll-a measurements from the Phragmites stands in the Rākosi Bay were arranged in 5 random series of 10 samples, when the following data were obtained (ug chl-a . cm^2):

	$\bar{x}$	s_x
1. series:	1,16	0.42
2. series:	1,02	0,47
3. series:	1,20	0.51
4. series:	1,02	0,53
5. series:	0.99	0,49

In a comparison with the above, the mean and standard error of 21 data were not significantly different ($\bar{x}$= 1.16, s_x=0,56). In other words, the twofold increase in sample size did not lead to any decrease in the standard error. Several samples and random selection showed that the mean and standard error stabilized at sample size of 10, further on was not changed by twofold increase in sample size. This sample size seems to be optimal, especially if we take into account the amount of effort expended. I believe it is necessary to carry out studies on optimal sample sizes on the Lake Fertö.

Outlyingly high valuesof periphyton chlorophyll-a content were measured on stems of Schoenoplectus litoralis in the open water of Rākosi Bay. Here there was as much chlorophyll-a (5 μg . cm^{-2}) as in plankton in one liter of water (6 μg . l^{-1}). This is especially interesting since this periphyton is exposed to strong currents of the water (the Schoenoplectus litoralis stand was loose, with water flowing freely between the stems). The periphyton of stands of Phragmites, Typha and Potamogeton in the Rākosi-Bay were exposed to currents of similar strenghts. The chlorophyll-a content of the Phragmites periphyton was roughly twice that of the other two stands. Similar results were obtained for samples from brown waters as well. It has been shown for other lakes too,that the periphyton on Phragmites is more profuse than on Typha. The usual explanation is that the surface of Phragmites is more suitable for the periphyton to settle on (Lāszlō TOTH, personal communication).

Chlorophyll-a content of periphyton in stands of Phragmites, Typha and Potamogeton were higher in brown waters than in the Rākosi Bay.

The highest PER was measured in the periphyton of Schoenoplectus litoralis stands. This is probably due to the high density of periphyton and perhaps to unfavourable conditions brought about by being exposed to the effects of waves. No other significant differences were detected in the variation of PER.

It must be mentioned that in stands of Schoenoplectus litoralis in the Rākosi Bay, some stems, 10-20 cm lower than the others, were strikingly bare in comparison with the others. Chlorophyll-a content was only 0,88 $\mu g \cdot cm^{-2}$ (n= 3). The PER was much lower than on stems covered with periphyton (1,40). We also measured the chlorophyll-a content of two reed stems covered with Cladophora. As expected, it was here the largest chlorophyll-a content was measured (9,29 $\pm$ $\mu g \cdot cm^{2}$, n= 2). At the same time the PER was not significantly different from the others (1,39).

The two mean values mentioned above were not included in the calculations.

Summary

Studies carried out between 14 and 18 July 1981 on the periphyton of the Hungarian side of Lake Fertö yielded the following results:

1) 214 species and subspecific taxa of algae were found in 7 samples of periphyton (Cyanophyta: 44, Euglenophyta:8, Pyrrophyta: 5, Chrysophyta: 114, Chlorophyta: 43). More species were found in brown waters than in the Rākosi-Bay.
2) The periphyton in the Rakosi Bay was mainly composed of diatoms, both as regards number of species and abundance. Besides these, there were many cyanophytes in lakes with brown waters. The periphyton was attached to the substrate plants in various ways, but similarly strongly in the case of Schoenoplectus litoralis in the Rākosi Bay, Phragmites and Typha in the Herrenlacken. The rest of the periphyton was of loose structure.

3) The periphyton in stands of various plant species was essentially not different floristically in a given locality.

4) The highest chlorophyll-a content of the periphyton in relation to the surface area of the substrate plant was measured on Schoenoplectus litoralis. The chlorophyll-a content in Phragmites was about twice that of Typha in the same localities. The periphyton of Potamogeton had chlorophyll content similar to that of Typha.

5) There were well defined floristical differences between the various collecting localities (the Rákosi Bay, open water; Rákosi Bay, edge of open water; Herrenlacken; Atjaró Lake) as shown by cluster analysis.

6) The chlorophyll-a content was higher in the periphyton of the three studied substrate species in lakes with brown water than in the Rákosi Bay.

The studies presented here show that the species composition of the periphyton is determined primarily by the characters of the locality. At several points, further studies are needed to supplement the results presented here. We have no data, e.g. on the seasonal variation in the quantity and quality of the periphyton. The simultaneous presence of dense and thin patches of periphyton on Schoenoplectus litoralis indicates that there may be sensitive periods for the colonialization by the periphyton. Such a study would by interest and a very important aspect of the research. It is certain, that investigations should be extended to cover other parts of the Hungarian side of the lake, and also to other species of substrate plants. Another problem to be studied: why and when is the periphyton of Phragmites more developed than that of Typha. Also, we do not know the functional parameters of the periphyton in the Lake Fertö. Further studies are aimed at in these directions.

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Zusammenfassung

Die Periphyton-Untersuchungen - die im ungarischen Teil des Fertö (Neusiedlersee) in der Zwischenzeit vom 14. bis 18. Juli 1981 durchgeführt wurden - ergaben folgende Ergebnisse.

1) Aus den 7 Periphyton-Proben wurden insgesamt 214 Arten bzw. subspezifische Taxa beschrieben (Cyanophyten: 44, Euglenophyten: 8, Pyrrophyten: 5, Chrysophyten: 114, Chlorophyten: 4^3). Aus den Braungewässern konnten insgesamt mehr Algen-Arten nachgewiesen werden, als aus der Rákoser Bucht.

2) Das Periphyton der Rákoser Bucht birgt - arten- und zahlenmässig - größtenteils Kieselalgen. In den Braungewässern waren außer diesen noch zahlreiche Cyanophyten anzutreffen. In der Rákoser Bucht ist das Periphyton abweichend, aber gleicherweise eng mit Schoenoplectus litoralis verbunden, in den Braungewässern mit Phragmites und Typha. Das übrige Periphyton bildet lockeres Gefüge.

3) An gleichen Sammelstellen konnte an dem an verschiedene Pflanzenarten gebundenen Periphyton kein wesentlicher floristischer Unterschied nachgewiesen werden.

4) Der höchste Chlorophyll-a-Gehalt des Periphytons wurde - auf Flächeneinheit der Substratpflanze berechnet - an Schoenoplectus litoralis gemessen. Der Chlorophyll-a-Gehalt der Phragmites- und der Typha-Bestände von gleicher Exposition erwies sich bei Phragmites

doppelt so hoch als bei Typha. Der Chlorophyll-Gehalt des Potamogeton-Periphytons war dem der Typha gleich.

5) Zwischen den aus verschiedenen Teilen des Sees (Rákoser Bucht, offenes Wasser; - Rákoser Bucht, Saum des offenen Wassers; - kleiner Herlacken; - Durchgangs-See) gesammelten Periphyton-Material konnten nennenswerte floristische Unterschiede verzeichnet werden, die auch mit der Cluster-Analyse erwiesen wurden. In den Braungewässern war der Chlorophyll-Gehalt bei allen drei verglichenen Pflanzenarten höher als in der Rákoser Bucht.

Unsere, aus verschiedener Sicht gewerteten Untersuchungen weisen darauf hin, daß die Artenzusammensetzung des Periphytons ausschlaggebend vom Charakter der Sammelstellen beeinflußt wird, wobei die Artenzugehörigkeit der Substratpflanze nur von sekundärer Bedeutung ist.

Die weiter oben angeführten Untersuchungen und deren Ergebnisse müssen noch an verschiedenen Stellen ergänzt werden. So stehen uns z.B. über die quantitative und qualitative saisonale Gestaltung des Periphytons überhaupt keine Angaben zur Verfügung. Das gleichzeitig sehr dichte, teilweise aber sehr spärliche Periphyton des Schoenoplectus litoralis in der Râkoser Bucht weist darauf hin, daß während der Kolonization besonders empfindliche Perioden bestehen können, deren Erkundung eine interessante und wichtige Forschungsaufgabe darstellt.
Allenfalls steht es fest, daß die Aufsammlungen auch an anderen Abschnitten des ungarischen Seegebietes, und auch an anderen Substratpflanzen durchgeführt werden müssen. Ein weiteres Problem das ebenfalls geklärt werden sollte ist die Frage: weshalb und von welchem Zeit-Faktor beeinflußt das Periphyton am Phragmites mehr entwickelt ist als auf Typha. Auch die Wirkungsparametern des Periphytons am Neusiedlersee sind uns unbekannt. In der Zukunft sind wir bestrebt diese Probleme zu lösen.

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Table 1

List of the species found in the sample of periphyton from 7 localities collected between 14 and 18 July 1981 in the Hungarian side of Lake Fertö

	Rákosi-Bay				Brown-water lakes		
	Phragmites communis	Typha angustifolia	Schoenoplectus litoralis	Potamogeton pectinatus	Phragmites communis	Typha angustifolia	Potamogeton pectinatus
	1.	2.	3.	4.	5.	6.	7.
Cyanophyta							
Chroococcales							
1. Aphanothece clathrata W. et G.S. West					+	+	
2. Chroococcus minutus var. obliteratus /Richt./Hansg.					+	+	+
3. Chroococcus turgidus /Kg./ Naeg.					+	+	
4. Dactylococcopsis acicularis Lemm.					+		
5. Dactylococcopsis raphidioides Hansg.					+		+
6. Gomphosphaeria lacustris Chodat.		+					+
7. Merismopedia glauca /Ehr./ Naeg.					+	+	+
8. Merismopedia marssonii Lemm.							+
9. Merismopedia punctata Mey.		+			+	+	+
10. Merismopedia trollerii Bachm.							+
11. Microcystis firma /Bréb. et Lenorm./ Schmidle						+	
12. Microcystis flos-aquae /Wittr./ Kirchn.				+			
13. Microcystis pulvera /Wood/ Forti							+
14. Rhabdonema lineare Schmidle et Lauterb.						+	+
15. Synechococcus cedrorum Sauv.					+	+	
16. Synechocystis salina Wisl.							+
Hormogonales							
17. Anabaena constricta /Szaf./ Geitl.						+	+
18. Anabaena viguiérii Denis et Frémy						+	
19. Lyngbya cryptovaginata Schkorb.			+	+	+	+	+
20. Lyngbya hyeronymusii Lemm.		+			+	+	+
21. Lyngbya kuetzingii Schmidle					+		+
22. Lyngbya limnetica Lemm.	+	+	+	+	+	+	+
23. Lyngbya martesiana Menegh.							+
24. Oscillatoria acutissima Kuff.						+	
25. Oscillatoria agardhii Gom.			+				
26. Oscillatoria amphybia Agh.					+	+	
27. Oscillatoria articulata Gardn.	+			+		+	
28. Oscillatoria chalybea /Mert./ Gom.					+		
29. Oscillatoria geminata Menegh.							+
30. Oscillatoria granulata Gardn.			+		+		+
31. Oscillatoria guttulata van Goor	+				+		
32. Oscillatoria limosa Agh.						+	

Table 1 (cont.)

	1.	2.	3.	4.	5.	6.	7.
33. Oscillatoria mougeotii Kg.	+	+					+
34. Oscillatoria neglecta Lemm.					+		
35. Oscillatoria planctonica Wolosz.					+		
36. Oscillatoria rubescens D. C.					+		
37. Oscillatoria sancta /Kg./ Gom.					+	+	
38. Oscillatoria tenuis Agh.		+		+	+	+	+
39. Pseudanabaena catenata Lauterb.					+	+	+
40. Spirulina abbreviata Lemm.							+
41. Spirulina laxissima G. S. West					+		+
42. Spirulina maior Kg.					+		
43. Spirulina subsalsa Oerst.	+	+	+	+	+	+	+
44. Spirulina subtilissima Kg.	+		+	+	+	+	
E u g l e n o p h y t a							
45. Euglena sp.		+	+	+		+	+
46. Euglena gracilis Klebs							+
47. Euglena oxyuris Schmarda		+	+				
48. Euglena tripteris /Duj./ Klebs	+			+			
49. Phacus curvicauda Pochm.	+	+			+	+	
50. Phacus pleuronectes /O.F.M./ Duj.		+					+
51. Phacus pusillus Lemm.				+			
52. Trachelomonas sp.						+	
P y r r o p h y t a							
Cryptophyceae							
53. Cryptomonas sp.	+				+		+
Dinophyceae							
54. Gymnodinium paradoxiforme Schiller							+
55. Peridinium sp.						+	
56. Peridinium cinctum /Mueller/ Ehr.							+
57. Peridinium inconspicuum Lemm.							+
C h r y s o p h y t a							
Xanthophyceae							
58. Goniochlorys spinosa Pasch.							+
59. Ophiocytium capitatum Wolle						+	
6 a Ophiocytium cochleare A. Br.						+	+
61. Ophiocytium majus Naeg.							+
Bacillariophyceae							
62. Achnanthes brevipes var. intermedia /Kuetz./ Cleve	+	+		+			+
63. Achnanthes delicatula Kuetz.			+				
64. Achnanthes lanceolata Bréb.	+	+		+			
65. Achnanthes lanceolata var. elliptica Cleve	+		+	+			
66. Achnanthes minutissima Kuetz.	+	+	+	+	+	+	+
67. Amphiprora costata Hust.		+					
68. Amphiprora paludosa W. Smith	+	+	+	+	+	+	+
69. Amphora coffeaeformis Agardh.							+
70. Amphora commutata Grun.		+					
71. Amphora ovalis Kuetz.	+	+		+	+	+	+
72. Amphora ovalis var. pediculus Kuetz.	+	+	+	+		+	+
73. Anomoeoneis sphaerophora var. sculpta /Ehr./ O. Muell.						+	+
74. Bacillaria paradoxa Gmelin	+	+	+	+	+		

Table 1 (cont.)

		1.	2.	3.	4.	5.	6.	7.
75.	Caloneis amphisbaena /Bory/ Cleve	+			+			
76.	Caloneis permagna /Bailey/ Cleve	+			+			
77.	Caloneis silicula var. peisonis Hust.					+	+	+
78.	Campylodiscus clypeus Ehr.	+	+	+	+	+	+	+
79.	Campylodiscus clypeus var. bicostatus /W. Smith/ Hust.	+	+		+	+	+	+
80.	Cocconeis pediculus Ehr.	+	+	+	+			
81.	Cocconeis placentula Ehr.	+	+	+	+	+		+
82.	Cocconeis placentula var. euglypta /Ehr./ Cleve		+	+	+		+	+
83.	Cocconeis placentula var. lineata /Ehr./ Cleve							+
84.	Cyclotella comta /Ehr./ Kuetz.			+				+
85.	Cyclotella meneghiniana Kuetz.	+	+	+	+	+	+	+
86.	Cyclotella ocellata Pant.	+	+					
87.	Cymatopleura elliptica /Bréb./ W. Smith		+		+			
88.	Cymatopleura elliptica var. constricta /Grun./	+	+					
89.	Cymatopleura solea /Bréb./ W. Smith		+		+			
90.	Cymbella affinis Kuetz.	+	+	+	+	+		+
91.	Cymbella aspera /Ehr./ Cleve		+					+
92.	Cymbella cistula /Hemprich/ Grun.	+	+	+	+	+	+	+
93.	Cymbella lacustris /Agardh/ Cleve		+		+	+		
94.	Cymbella lanceolata /Ehr./ v. Heurck	+			+			
95.	Cymbella pusilla Grun.		+			+	+	+
96.	Cymbella ventricosa Kuetz.							+
97.	Diatoma elongatum Agardh	+	+	+	+	+		
98.	Diatoma elongatum var. minor Grun.	+						
99.	Diatoma elongatum var. tenuis /Agardh/ Kuetz.	+	+		+			
100.	Epithemia sorex Kuetz.		+		+			
101.	Epithemia turgida /Ehr./ Kuetz.		+					
102.	Epithemia zebra /Ehr. / Kuetz.					+	+	+
103.	Epithemia zebra var. porcellus /Kuetz./ Grun.	+	+		+			
104.	Epithemia zebra var. saxonica /Kuetz./Grun.							+
105.	Eunotia lunaris /Ehr./ Grun.							+
106.	Eunotia lunaris var. capitata Grun.							+
107.	Fragilaria brevistriata Grun.							+
108.	Fragilaria brevistriata var. inflata /Pant./ Hust.			+				
109.	Fragilaria capucina Desmaziéres							+
110.	Gomphonema acuminatum Ehr.							+
111.	Gomphonema acuminatum var. brébissonii /Kuetz./ Cleve	+	+		+			
112.	Gomphonema acuminatum var. trigonocephala /Ehr./ Grun.		+				+	
113.	Gomphonema constrictum Ehr.						+	
114.	Gomphonema constrictum var. capitatum /Ehr./ Cleve	+		+		+	+	+
115.	Gomphonema longiceps Ehr.					+		
116.	Gomphonema longiceps var. subclavatum Grun.						+	
117.	Gomphonema longiceps f. suecica Grun.	+	+		+		+	+
118.	Gomphonema olivaceum /Lyngb./ Kuetz.	+	+	+	+			+
119.	Gomphonema olivaceum var. calcarea Cleve	+	+	+		+	+	+
120.	Gyrosigma spencerii /W. Smith/ Cleve	+	+		+			
121.	Hantzschia amphioxys /Ehr./ Grun.				+			
122.	Mastoglia smithii var. amphicephala Grun.				+	+		+
123.	Melosira varians C. A. Ag.	+	+		+			

		1.	2.	3.	4.	5.	6.	7.
124.	Navicula cryptocephala Kuetz.	+	+	+	+	+	+	+
125.	Navicula cuspidata Kuetz.	+	+			+	+	+
126.	Navicula cuspidata var. ambigua /Ehr./ Cleve				+			
127.	Navicula dicephala /Ehr./ W. Smith	+		+	+		+	+
128.	Navicula gracilis Ehr.	+	+	+	+			+
129.	Navicula halophyla Hust.						+	+
130.	Navicula oblonga Kuetz.	+			+	+	+	+
131.	Navicula protracta Grun.						+	
132.	Navicula pupula var. capitata Hust.	+				+	+	+
133.	Navicula radiosa Kuetz.	+	+		+	+	+	+
134.	Navicula radiosa var. tenella /Bréb./ Grun.	+	+	+	+			+
135.	Navicula stundlii Hust.			+				
136.	Navicula tenuipunctata Hust.			+			+	
137.	Nitzschia acicularoides Hust.		+	+	+			
138.	Nitzschia amphibia Grun.							+
139.	Nitzschia filiformis /W. Smith/ Hust.		+	+	+		+	
140.	Nitzschia geitlerii Hust.				+	+		+
141.	Nitzschia hungarica Grun.	+	+		+			+
142.	Nitzschia hybrida Grun.	+	+					
143.	Nitzschia kuetzigiana Hilse	+			+			
144.	Nitzschia kuetzingioides Hust.				+			
145.	Nitzschia leglerii Hust.				+		+	
146.	Nitzschia lorenziana var. subtilis Grun.	+	+	+	+			
147.	Nitzschia sigma /Kuetz./ W. Smith		+					
148.	Nitzschia sigmoidea /Ehr./ W. Smith	+	+		+	+	+	+
149.	Nitzschia spectabilis /Ehr./ Ralfs.	+						
150.	Nitzschia sublinearis Hust.							+
151.	Nitzschia tryblionella Hantzsch	+	+		+			
152.	Nitzschia tryblionella var. debilis /Arnott/ A. Mayer	+	+	+	+			
153.	Nitzschia tryblionella var. levidiensis /W. Smith/ Grun.						+	
154.	Pinnularia microstauron var. brébissonii /Kuetz./ Hust.					+	+	
155.	Pinnularia molaris Grun.	+						
156.	Rhoicosphaenia curvata /Kuetz./ Grun.	+	+	+	+	+	+	+
157.	Rhopalodia gibba /Ehr./ O. Muell.	+	+	+	+	+	+	+
158.	Rhopalodia gibba var. ventricosa /Ehr./ Grun.		+					
159.	Rhopalodia gibberula /Ehr./ O. Muell.		+					
160.	Surirella hoeflerii Hust.	+		+	+			
161.	Surirella ovalis Bréb.	+						
162.	Surirella ovata Kuetz.	+	+	+	+			
163.	Surirella peisonis Pant.	+	+	+	+	+		
164.	Synedra acus var. radians /Kuetz./ Hust.	+	+	+	+	+	+	+
165.	Synedra capitata Ehr.		+			+	+	+
166.	Synedra pulchella Kuetz.				+			
167.	Synedra ulna /Nitzsch/ Ehr.	+	+	+	+	+	+	+
168.	Synedra ulna var. biceps /Kuetz./v. Schönf.	+	+	+	+	+	+	+
169.	Synedra ulna var. spatulifera Grun.							+
170.	Synedra vaucheriae Kuetz.		+		+			
171.	Synedra vaucheriae var. truncata /Greville/ Grun.		+					
	lorophyta							
	Volvocales							
172.	Chlamydomonas sp.			+				
173.	Pandorina morum /Muell./ Bory							+

		1.	2.	3.	4.	5.	6.	7.
	Chlorococcales							
174.	Ankistrodesmus angustus Bern.		+		+	+		
175.	Ankistrodesmus fusiformis Corda sensu Kors.							+
176.	Ankistrodesmus pseudobraunii Belch. et Sw. non Kiss	+	+				+	+
177.	Crucigenia quadrata Morren	+	+	+				
178.	Elakatothrix lacustris Kors.							+
179.	Hyaloraphidium contortum Pascher et Kors.					+		
180.	Oocystis sp.	+	+				+	+
181.	Oocystis lacustris Chod.	+			+			
182.	Pediastrum boryanum /Turp./ Menegh.				+			
183.	Pediastrum duplex Meyen	+	+	+	+			
184.	Scenedesmus acutus Meyen							+
185.	Scenedesmus bicaudatus /Hansg./ Chod.							+
186.	Scenedesmus ecornis /Ralfs./ Chod.							+
187.	Scenedesmus ecornis var. disciformis Chod.							+
188.	Scenedesmus intermedius Chod.			+	+			
189.	Scenedesmus quadricauda /Turp./ Bréb.	+	+			+	+	+
190.	Schroederia nitzschioides /G. S. West/ Kors.	+	+	+				
191.	Schroederia robusta Kors.	+			+			
192.	Schroederia setigera /Schroed./ Lemm.	+		+	+			
193.	Selenastrum bibraianum Reinsch.							+
194.	Tetraedron minimum /A. Br./ Hansg.							+
195.	Tetraedron minimum var. tetralobulatum Reinsch.						+	
196.	Tetraedron quadratum /Reinsch./ Hansg.							+
	Ulotrichales							
197.	Oedogonium sp.	+						+
198.	Ulothrix sp.			+	+			
	Zygnematales							
199.	Spirogyra sp.	+		+		+	+	+
	Desmidiales							
200.	Closterium aciculare Hantzsch							+
201.	Closterium dianae Ehr.	+			+		+	+
202.	Closterium parvulum Naeg.		+	+	+			
203.	Cosmarium biretum var. trigibberum Nordst.					+	+	+
204.	Cosmarium bortytis Menegh.					+		+
205.	Cosmarium clepsydra var. bicardia /Reinsch./ Croasd.		+					
206.	Cosmarium depressum /Naeg./ Lund.		+	+				
207.	Cosmarium granatum Bréb.						+	
208.	Cosmarium humile var. glabrum Gutw.							+
209.	Cosmarium praecisum var. suecicum /Borge/ Krieg.							+
210.	Cosmarium scopulorum Borge		+					+
211.	Cosmarium umbilicatum Lütk.							+
212.	Cosmarium varsoviense Racib.							+
213.	Staurastrum alternans Bréb.							+
214.	Staurastrum hexacerum /Ehr./ Wittr.	+			+			

Table 2

Number of species found in periphyton on the Hungarian side of Lake Fertö between 14 and 18 July 1981

	Rákosi-Bay				Brown-water lakes		
	Phragmites communis	Typha angustifolia	Schoenoplectus litoralis	Potamogeton pectinatus	Phragmites communis	Typha angustifolia	Potamogeton pectinatus
Cyanophyta	6	7	6	7	26	22	24
Chroococcales	-	2	-	1	8	8	10
Hormogonales	6	5	6	6	18	14	14
Euglenophyta	2	4	2	3	1	3	3
Pyrrophyta	1	-	-	-	1	1	4
Cryptophyceae	1	-	-	-	1	-	1
Dinophyceae	-	-	-	-	-	1	3
Chrysophyta	57	62	37	61	34	41	56
Xanthophyceae	-	-	-	-	-	2	3
Bacillariophyceae	57	62	37	61	34	39	53
Chlorophyta	13	11	10	11	6	9	25
Volvocales	-	-	1	-	-	-	1
Chlorococcales	9	7	5	7	3	5	12
Ulotrichales	1	-	1	1	-	-	1
Zygnematales	1	-	1	-	1	1	1
Desmidiales	2	4	2	3	2	3	10
Total	79	84	55	82	68	76	112

Table 3

		number of samples	chlorophyll-a conc. $\mu g \cdot cm^{-2}$ $\bar{X}$	s_x	E_{480}/E_{666} $\bar{Y}$	s_y
Rákosi-Bay	Phragmites communis	21	1.16	0.56	1.40	0.09
	Typha angustifolia	19	0.49	0.32	1.43	0.08
	Schoenoplectus litoralis	7	5.03	1.68	1.70	0.75
	Potamogeton pectinatus	20	0.56	0.18	1.55	0.08
Brown-water lakes	Phragmites communis	10	2.33	0.80	1.59	0.26
	Typha angustifolia	5	1.38	0.67	1.32	0.05
	Potamogeton pectinatus	10	1.26	0.40	1.42	0.22

Variation in chlorophyll-a content of periphyton in the Hungarian part of Lake Fertö between 14 and 18 July

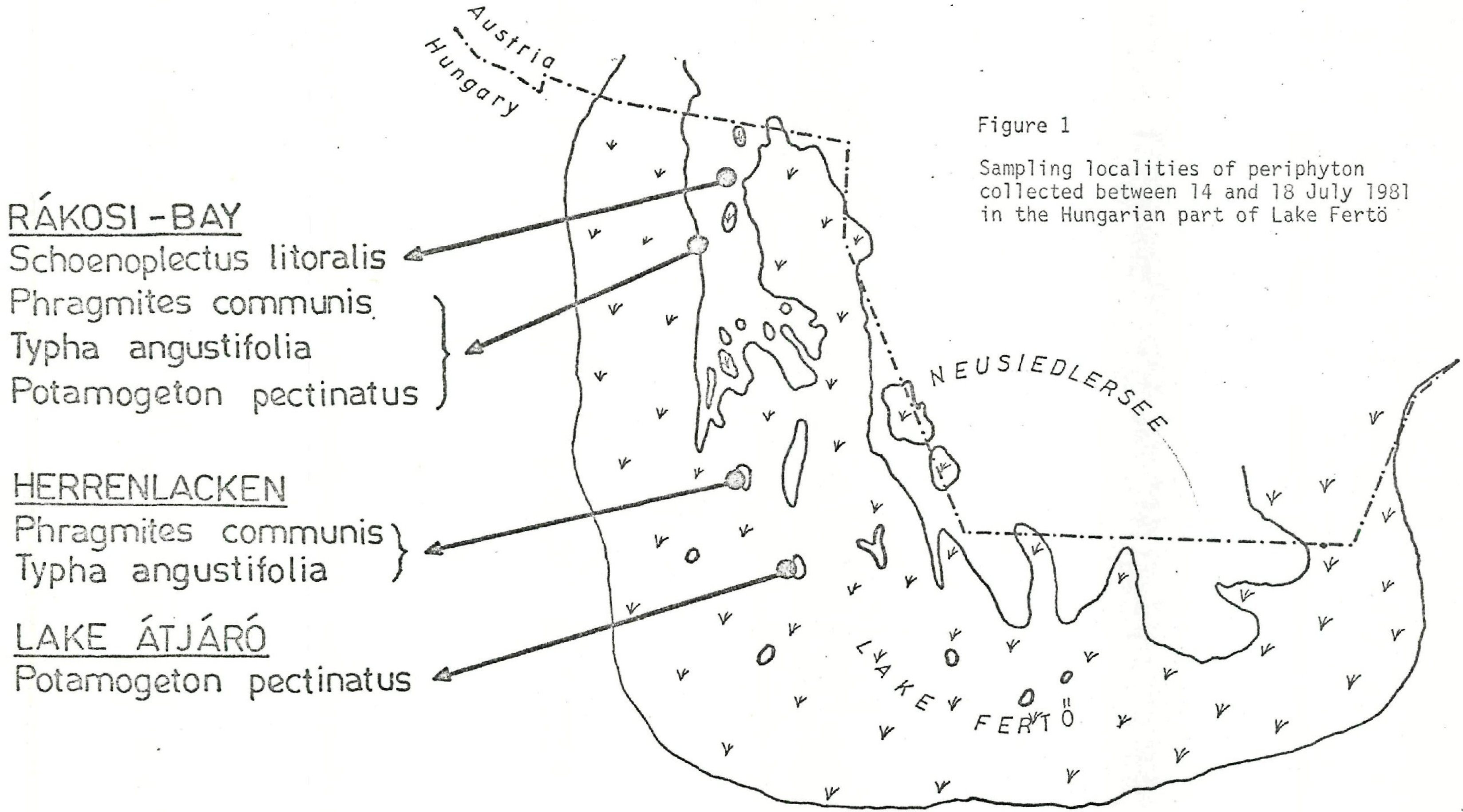
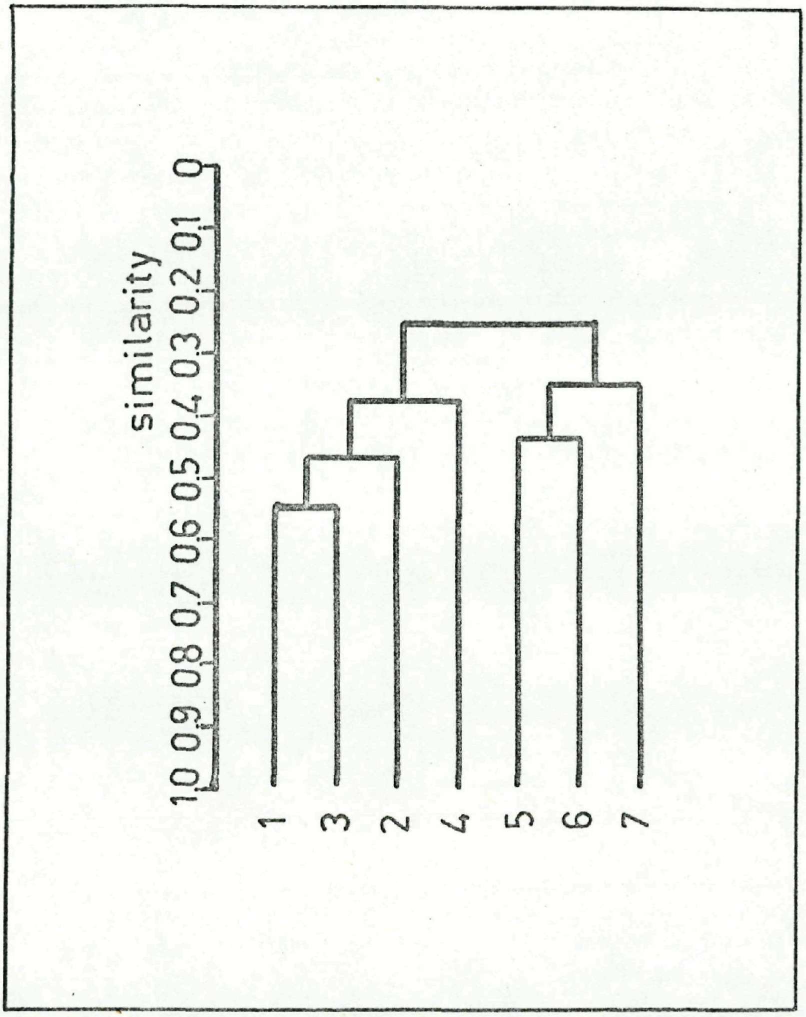


Figure 1

Sampling localities of periphyton collected between 14 and 18 July 1981 in the Hungarian part of Lake Fertö

Fig. 2



Dendrogram of cluster analysis of algological data of periphyton collected between 14 and 18 July 1981 from Lake Fertö (1.: Phragmites communis, Rákosi Bay; 2.: Typha angustifolia, Rákosi Bay; 3.: Potamogeton pectinatus, Rákosi Bay; 4.: Schoenoplectus litoralis, Rákosi Bay; 5.: Phragmites communis, Herrenlacken; 6.Typha angustifolia, Herren-lacken; 7.: Potamogeton pectinatus, Lake Ätjárö)