STUDIA BOTANICA HUNGARICA
(Antea: Fragmenta Botanica)
XIX. 1986 p. 63-71

A comparative study of the periphytic algae on three different flower plant species in Lake Hidegségi Fertő, Hungary

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(Received November 30, 1985)

Abstract: Substrate specificity of the periphytic algae upon three aquatic flower plants were examined in Lake Hidegségi (Fertő). One hundred and five taxa were identified. It has been found that the diversity of periphyton samples of Typha angustifolia was greater than the diversity of epiphytic algal assemblages of Schoenoplectus litoralis and Phragmites communis. The floristical differences among the periphyton of Schoenoplectus and Phragmites were shown with the help of cluster analysis. With 1 table and 4 figures.

INTRODUCTION

Though Lake Fertő is the second largest lake of Hungary its intensive algological research began only in recent years. Concerning the algae living on macrophyta, floristical data are reported altogether only in five publications (LOUB 1955, HUSTEDT 1959a, 1959b, 1959c, PADISÁK 1982). However, studying the periphyton of Lake Fertő would be particularly interesting since the Hungarian part of the lake is covered by continuous reed up to 82% (BÁCSATYAI et al. 1983), thus it is the largest undrained swamp of Hungary. ALLEN (1971) estimated that more than 20 percent of the total lake production could be attributed to attached algae so the quantity and quality of the periphyton is not in the least negligible for the water qualification of Lake Fertő.

Lake Hidegségi is one of the several inner lakes to be found in the reed-belt of Fertő. The lake is mainly surrounded by Phragmites communis mixed with very few Typha angustifolia. Schoenoplectus litoralis forms separate islands on the lake. The water of the inner lakes is typically brown differing from the grey colour of the open water. PADISÁK (1982) found that the difference between the periphyton of the grey and the brown water is greater than the periphyton of different substrate plants, e.g. the difference of the periphyton of Phragmites living in grey and brown water is greater than the difference between the periphyton of Phragmites and Typha in brown water. PADISÁK studied the periphyton of only 1 substrate plant of Phragmites and Typha. Besides obtaining additional floristical data, the purposes of the present study are to examine the following

1. the dominance properties of the periphyton
2. if there is a real floristical difference between the periphyton of different substrate plants i.e., whether the periphytons of two Phragmites are more similar than that of a Phragmites and a Typha
3. if there is any difference between the diversity of the periphytons.

MATERIALS AND METHODS

Samples of periphyton were collected on 9 November, 1983 from stands of three different

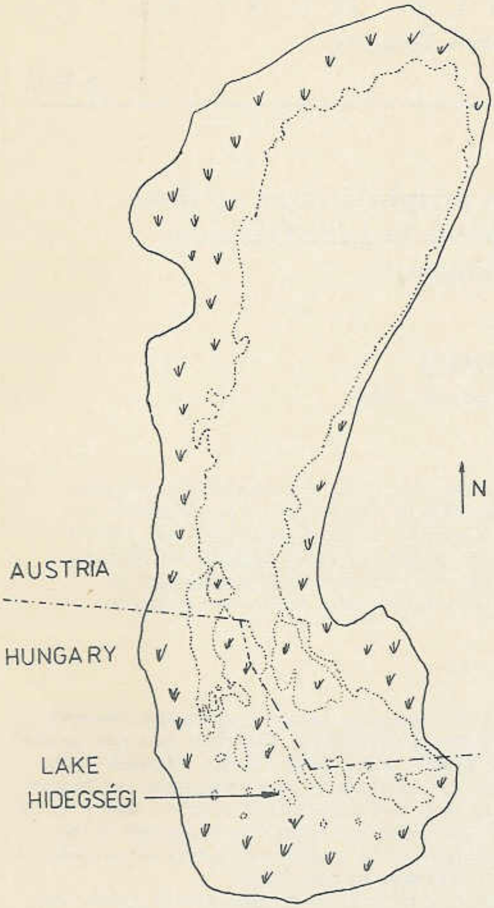

Fig. 1. Location of sampling position

flower plants (Phragmites communis, Typha angustifolia, Schoenoplectus litoralis) located in Lake Hidegségi (Fig. 1). From each substrate plant type 15 repetition were collected to obtain statistically reliable results. In the case of Phragmites and Schoenoplectus the abovewater parts were cut off, then a glass tube (13 mm diameter, 0.2 m in length) was pulled over the underwater stump and cut off at end the tube. The lower end of the tube was closed and the section of the stem thus transvered to a collecting jar. In this way the samples contained the loosely attached layer too (LAZAREK 1982). Sections of Typha angustifolia were collected without the use of tube, because the diameter of Typha is larger then 13 mm. The periphyton was thoroughly scraped off from the sections of stem within 48 hours, and then the samples of periphyton were fixed in formaldehyde solution (2-4 %). The permanent diatom slides were prepared with the H_2O_2 method of HORVÁTH(1975). Four hundred individuals were counted in each sample to yield a counting accuracy of $\pm$ 10 % (LUND et al. 1958).

The Shannon diversity index were calculated for each sample (SHANNON 1948). Floristical data were analyzed using cluster analysis based on Jaccard's measure (JACCARD 1908), and WPGMA fusion algorithy (SNEATH & SOKAL 1973). For the calculations the BP programme package was used (RAJCZY & HAJDU 1981).

RESULTS

One hundred and five taxa were identified during the study (Cyanophyta 3, Chrysophyta-Bacillariophyceae 98, Chlorophyta 4). These are listed in Table I. The high percentage of diatoms is remarkable because of the total number of individuals (92.5 %). Diatoms are practically fully dominant on Phragmites and Schoenoplectus (99.7 % and 99.9 % respectively), while on Typha the relative frequency of individuals of blue-green and green algae is 13 % (Fig. 2). The most prevalent diatom throughout the study was Achnanthes minutissima occurring on every macrophyte stem section studied. On Schoenoplectus and Phragmites it gave 70 % of the total number of individuals on the average, while 48 % of the algae living on Typha belonged to this algae of minute size. In addition, the following taxa of considerable quantity were found (averages): Diatoma elongatum 14 %, Oscillatoria sp. 4.6 %, Cocconeis pediculus 2.4 %, Bacillaria paradoxa 2.1 %, Synedra acus 1.6 %, Gomphonema sp. 1.2 %, Rhoicosphenia curvata 1.1 %. These taxa were found on all the three kinds of substrate. The number of taxa found only on one substrate is the following: on Phragmites 11, on Schoenoplectus 17, on Typha 24. I found a total of 54 taxa on Phragmites, 57 taxa on Schoenoplectus and 74 taxa on Typha.

Cluster dendrogram of samples based on Jaccard's measure is shown in Fig. 3. Two large groups are separated. One contains samples mainly from Schoenoplectus and Typha, and the other contains all the samples from Phragmites, three samples from Schoenoplectus and two samples from Typha. The two samples joining supplementarily are from Typha and Schoenoplectus, respec-

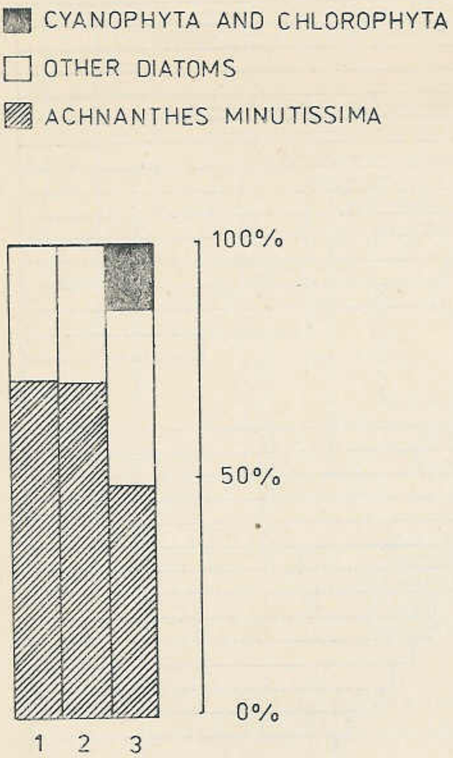

Fig. 2. Percentage contribution of periphytic diatoms and other algae relative to total number of individuals, upon three aquatic flower plants in Lake Hidegségi. (1 = Phragmites communis, 2 = Schoenoplectus litoralis, 3 = Typha angustifolia)

tively. Hence the periphyton of Phragmites and Schoenoplectus are well separated, while the periphyton of Typha is mixed with them.

Fig. 4 shows the diversity of the 3 x 15 samples in increasing order. Looking at the diversity values between 2 and 3 we can notice that there are 10 samples in this interval from Typha, while from Phragmites and Schoenoplectus only 3 and 1, respectively. That is to say, the diversity of the samples from Typha is greater than that of the other samples.

DISCUSSION

Considering the abundance of the taxa my results are well in coincidence with the data of previous periphyton analyses made on Lake Fertő. PADISÁK (1982) found 68 taxa on Phragmites and 76 on Typha in Lake Herlakni this is another small brown-water inner lake of the Fertő. The dissimilarity in the distribution according to phyla is remarkable. She found 34 diatoms on Phragmites an 29 on Typha. Presumably the reason for the considerable difference is seasonal succession. Padisák elaborated samples from July, while the present sampling was in November. The temperature optimum of diatoms is considerably lower than that of algae of other phyla (PADISÁK 1985), so this can be the reason for the strong diatom dominance in late autumn. There are very few studies on seasonal changes of periphyton communities on natural substrates, mainly due to a large number of methodological difficulties. The results of colonization studies on artificial substrate just because of host-specificity cannot be applied. A further problem is that in many studies only the seasonal changes of diatoms are analyzed (e.g. BLINN et al 1980, MILLIE et al 1983). Since we only planned such studied on Fertő, we are mainly reduced to conjectures.

The result of cluster analysis shows that Phragmites and Schoenoplectus are well separated from each other so there is a considerable difference between them. The periphyton of Typha is mixed with both of them. The two supplementarily joining samples contain very few taxa (their diversity is less than 1), one contains 10, the other 4 taxa only. However, these taxa are common so these are not separated from the other samples. Considering diversities, the periphyton of Phragmites and Schoenoplectus seems to be similar while the diversity of algae living on Typha is greater. Comparing the lists of taxa it is clear that Achnanthes minutissima can be found on Typha in considerably smaller number than on the two other substrates. Thus most prevalent taxa is responsible for the dissimilarity of diversities.

We can state that the periphytons of all the three substrates are different. The periphytonn of Phragmites and Schoenoplectus are different floristically, while the periphyton of Typha differs from the other two in its diversity. The purpose of further studies is to calrify distribution and colonization patterns of periphytic algae on these three macrophyte hosts after which the dissimilarities found in this study can probably be explained.

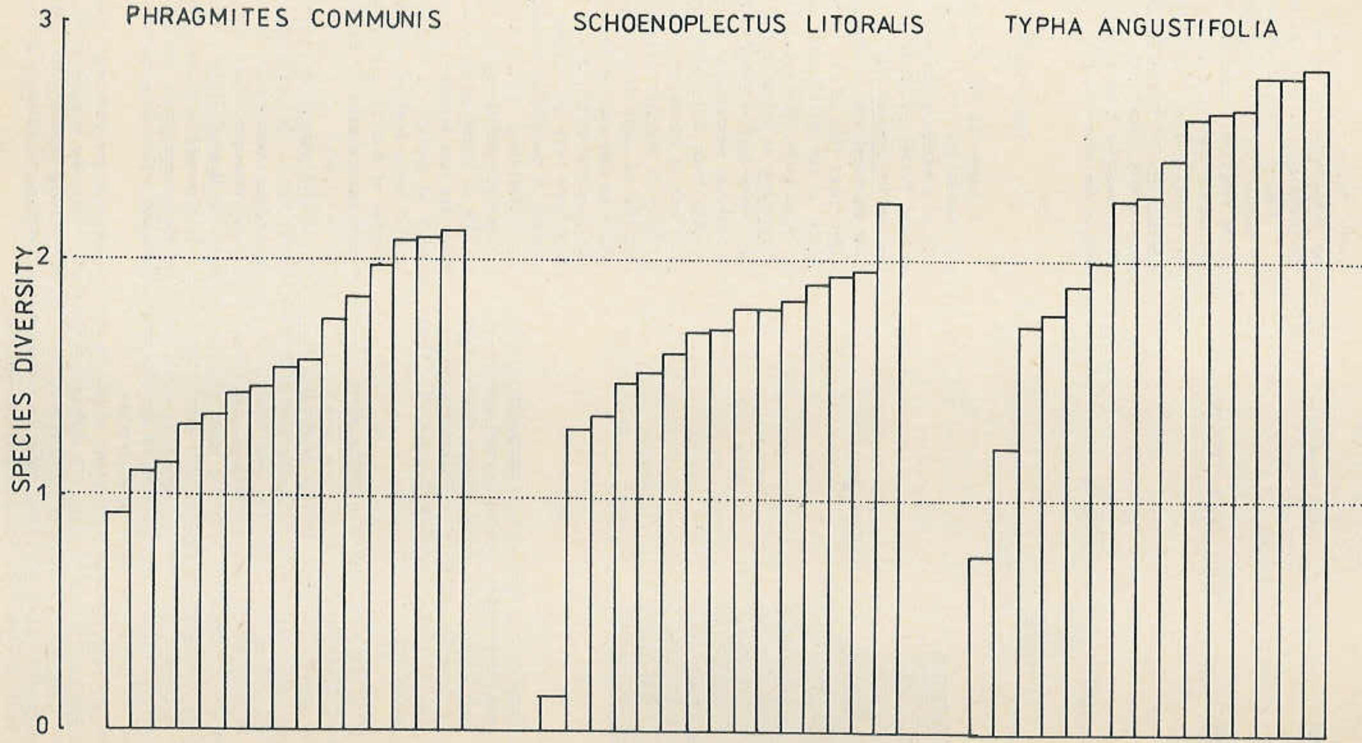

Fig. 3. Diversity distribution of the samples

Acknowledgement - I would like to express my thanks to Dr. J. PADISÁK for her help and advice. Thanks are also due to Dr. M. RAJCZY who made the BP programme package available to me.

Table 1. List of periphytic algae found on the three studied substrate species in the Lake Hidegségi of the Lake Fertő. (I. Phragmithes communis, II. Schoenoplectus litoralis, III. Typha angustipholia, a. number of individual min:1, max: 6000, b. number of occurrences min:1, max:15)

	I.		II.		III.	
	a.	b.	a.	b.	a.	b.
Cyanophyta						
1. Microcystis sp.	8	3	-	-	2	2
2. Oscillatoria amphibia Agh.	1	1	-	-	12	2
3. Oscillatoria sp.	8	3	6	4	811	8
Xanthophyta- Bacillariophyceae						
4. Achnanthes linearis W. Smith	-	-	-	-	1	1
5. A. minutissima Kütz.	4253	15	4222	15	2912	15
6. Amphiprora alata Kütz.	-	-	-	-	3	3
7. A. costata Hust.	2	1	-	-	-	-
8. A. paludosa W. Smith	-	-	1	1	-	-
9. Amphora commutata Grun.	-	-	3	3	4	2
10. A. ovalis var. pediculus Kütz.	6	5	5	4	7	3
11. A. veneta (Kütz.)	-	-	-	-	172	11
12. Anomoeonis sphaerophora (Kütz.) Pfitzner	-	-	3	3	-	-
13. A.sphaerophora var. polygramma (Ehr.) O.Müll	-	-	3	1	-	-
14. A.sphaerophora var. sculpta (Ehr.) O.Müll.	-	-	4	2	-	-
15. Bacillaria paradoxa Gmelin	76	14	40	12	264	14
16. Campylodiscus clypeus Ehr.	2	2	4	3	5	5
17. Cocconeis pediculus Ehr.	90	13	96	13	246	15
18. C. placentula Ehr.	1	1	22	7	8	5
19. C. placentula var. euglypta (Ehr.) Cleve	2	1	-	-	1	1
20. C. thumensis A. Mayer	1	1	-	-	-	-
21. Cyclotella catenata Brun.	-	-	1	1	1	1
22. C. meneghiniana Kütz.	1	1	2	2	1	1
23. Cymbella affinis Kütz.	8	4	24	10	25	9
24. C. aspera (Ehr.) Cleve	-	-	-	-	2	1
25. C. brehmii Hust.	-	-	-	-	16	7
26. C. cistula (Hemprich) Grun.	1	1	6	4	5	2
27. C. cistula var. maculata (Kütz.) v. Heurck	-	-	1	1	5	2
28. C. lacustris (Agardh) Cleve	13	4	31	6	2	2
29. C. microcephala Grun.	9	4	5	3	6	4
30. C. prostrata (Berkeley) Cleve	5	3	1	1	-	-
31. C. pusilla Grun.	13	10	7	7	3	3
32. C. tumidula Grun.	1	1	-	-	-	-
33. C. ventricosa Kütz.	39	13	40	11	57	12
34. Cymbella sp.	64	13	-	-	96	12
35. Diatoma elongatum Agardh	900	15	884	15	819	15
36. D. elongatum var. minor Grunow	-	-	30	8	54	8
37. D. vulgare Bora	-	-	-	-	4	4
38. D. vulgare var. ovalis (Fricke) Hustedt	-	-	-	-	7	3
39. Epithemia sorex Kütz.	-	-	1	1	-	-
40. E. zebra (Ehr.) Kütz.	-	-	-	-	1	1
41. E. zebra var. saxonica (Kütz.) Grun.	-	-	-	-	1	1
42. Eunotia gracilis (Ehr.) Rabenhorst	-	-	-	-	1	1

Table 1 (continued)

	I.		II.		III.	
	a.	b.	a.	b.	a.	b.
43. E. lunaris (Ehr.) Grunow	1	1	-	-	-	-
44. Fragilaria construens (Ehr.) Grunow	-	-	1	1	-	-
45. F. construens var. binodis (Ehr.) Grunow	1	1	-	-	1	1
46. F. intermedia Grunow	-	-	-	-	22	1
47. Gomphonema acuminatum var. brebissonii (Kütz.) Cleve	1	1	1	1	1	1
48. G. gracile Ehr.	-	-	-	-	1	1
49. G. longiceps var. montana f. suecica Grun.	-	-	-	-	2	1
50. G. longiceps var. subclavata Grun.	2	1	-	-	2	1
51. G. longiceps var. subclavata f. gracilis Hust.	4	3	-	-	-	-
52. G. olivaceum (Lyngbye) Kütz.	-	-	1	1	7	4
53. G. olivaceum var. calcarea Cleve	1	1	34	11	15	8
54. Gomphonema sp.	103	13	37	8	70	11
55. Gyrosigma sp.	1	1	-	-	-	-
56. Mastoglia smithii var. amphicephala Grun.	-	-	-	-	1	1
57. M. smithii var. lacustris Grun.	-	-	6	4	1	1
58. Melosira granulata? (Ehr.) Ralfs	-	-	-	-	2	1
59. M. varians C.A. Ag.	-	-	-	-	1	1
60. Navicula cryptocephala Kütz.	3	2	-	-	8	6
61. N. cryptocephala var. intermedia Grun.	-	-	1	1	-	-
62. N. cryptocephala var. veneta (Kütz.) Grun.	68	13	15	8	38	13
63. N. cuspidata Kütz.	1	1	2	2	-	-
64. N. cuspidata var. ambiqua (Ehr.) Cleve	1	1	-	-	-	-
65. N. dicephala (Ehr.) W. Smith	-	-	1	1	-	-
66. N. gregaria Donkin	1	1	-	-	-	-
67. N. halophila (Grun.) Cleve	-	-	4	4	11	5
68. N. oblonga Kütz.	2	2	12	6	6	5
69. N. pusilla W. Smith	-	-	-	-	1	1
70. N. radiosa Kütz.	10	6	13	10	15	7
71. Navicula sp.	1	1	-	-	-	-
72. Nitzschia admissa Hust.	1	1	-	-	-	-
73. N. amphibia Grun.	17	8	16	6	7	5
74. N. amphibia f. rostrata Hust.	-	-	1	1	-	-
75. N. angustata W. Smith	2	1	-	-	-	-
76. N. fonticola Grun.	-	-	-	-	2	1
77. N. frustulum Kütz.	-	-	-	-	3	1
78. N. hungarica Grun.	-	-	3	2	1	1
79. N. obtusa W. Smith	1	1	1	1	-	-
80. N. palea (Kütz.) W. Smith	1	1	-	-	6	1
81. N. paleacea Grun.	-	-	-	-	3	2
82. N. romana Grun.	-	-	2	1	-	-
83. N. sigma (Kütz). W. Smith	-	-	3	2	-	-
84. N. sigmoidea (Ehr.) W. Smith	-	-	-	-	4	4
85. N. trybiionella Hantzsch	-	-	1	1	-	-
86. Nitzschia sp.	7	4	-	-	1	1
87. Rhoicosphenia curvata (Kütz.) Grun.	118	13	22	12	65	13
88. Rhopalodia gibba (Ehr.) O. Müll.	-	-	1	1	-	-
89. R. gibba var. ventricosa (Ehr.) Grun.	-	-	-	-	1	1
90. Stephanodiscus sp.	-	-	1	1	-	-
91. Synedra actiastroides Lemmermann	-	-	1	1	-	-
92. S. acus Kütz.	60	12	208	14	17	9
93. S. affinis Kütz.	12	7	39	10	38	10
94. S. amphicephala Kütz.	2	1	-	-	1	1
95. S. capitata Ehr.	-	-	7	4	5	3
96. S. pulchella Kütz.	-	-	-	-	2	1

Table 1 (continued)

	I.		II.		III.	
	a.	b.	a.	b.	a.	b.
97. S. ulna (Nitzsch) Ehr.	41	13	94	15	38	12
98. S. ulna var. amphirhynchus (Ehr.) Grun.	1	1	-	-	1	1
99. S. vaucheriae Kütz.	2	1	5	4	1	1
100. Pennales sp.	-	-	5	4	-	-
101. Bacillariophyceae sp.	-	-	8	7	25	6
Chlorophyta						
102. Cosmarium sp.	-	-	1	1	-	-
103. Scenedesmus quadricauda (Turp.) Bréb.	-	-	-	-	1	1
104. Scenedesmus sp.	1	1	1	1	1	1
105. Spirogyra sp.	1	1	-	-	6	3

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