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THE BIOMASS CHANGES OF MICROPHYTOBENTHOS IN LAKE BALATON DURING THE 1960S

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The qualitative composition of the microphytobenthos in the open-water sediment surface was described in a number of studies (PANTOCSEK, 1902; 1902 a; KOL, 1938; ENTZ et al., 1963). The calculation of its number of individuals for cm^2 was reported in various works (ENTZ, 1954; ENTZ and TAMÁS, 1952; TAMÁS, 1966; 1967; 1968; 1971).

The aim of the present study was to calculate the wet weight of algal carpet in mg/cm^2 from the number of individuals of the microphytobenthos and the mean value of each of the species for the years of 1965, 1966 and 1967.

Methods

Since the spring of 1965, the period of a large fish destruction in Lake Balaton, samples has been taken from the five transversal sections of the lake (M, K, G, A and E) with Ekman-Birge dredge. On the sample of $\sim$ 114 cm^2 taken from the sediment surface algological and zoological (PONYI, 1966) determinations were made. In 1966 and 1967 we used the modified Craib's sampler (PONYI et al., 1967). In these two years samplings were made at three points of the five transversal sections. The number of years, months, samplings, alga species, varieties and the total algae is given in *Table 1.*

When making the quantitative determinations of algae (number of individuals and biomass) we adapted the time-honoured method employed in

TABLE 1

Data on the samples of microphytobenthos in Lake Balaton (year, month, number of samplings, number of species and varieties, total algae)

Year	Month	Number of samplings	Species	Variety	Total
1965.	VI—X.	25	94	7	101
1966.	V—XI.	105	107	6	113
1967.	IV—X.	115	80	5	85

earlier investigations of the microphytobenthos (ENTZ and TAMÁS, 1952; ENTZ, 1954).

Results and discussion

The data on the qualitative composition and population density of the algal carpet living on the surface of the mud, together with a good knowledge of the phytoplankton, are important factors to explain the qualitative and quantitative change taking place in the fauna of the lake. On the one hand, while evaluating the data, the occurrence, distribution and the number of the individuals in Lake Balaton (transversal sections) of the new species focus attention on the change itself and on the tendency of change of the environment. On the other hand, the algal cover of the sediment surface serves as food source to the Chironomida (ENTZ, 1964), Nematoda species (BIRÓ, 1968; 1973) and fish (ENTZ and LUKACSOVICS, 1957) feeding on it. In the environment of Lake Balaton the composition and quantity of microphytobenthos are important links in the food chain.

The values of total biomass were calculated by multiplying the mean value of the algal species each with the number of individuals. When calculating the number of individuals we considered only living algae, dead or fragmentary parts were disregarded.

In addition to the algal volumes published in previous studies (SEBESTYÉN, 1954; TAMÁS, 1955; 1974; HERODEK and TAMÁS, 1973; 1974) the following values were recorded:

1000 μ^3 (of small size and quantity)

Achnanthes dispar	300
A. minutissima	560
Cymbella prostrata	400
Epithemia intermedia	800
E. zebra	500
Eunotia valida	500
Fragilaria pinnata	400
Navicula costulata	390
N. dicephala	1000
N. pupula	570

1000—10 000 μ^3 (of moderate size and quantity)

Amphora perpusilla	3000
Cocconeis diminuta	2260
Cymbella cymbiformis	4700
C. ehrenbergii	5300
C. lanceolata	6000
Diatoma vulgare var. *brevis*	1700
D. vulgare var. *linearis*	3000
D. vulgare var. *producta*	1700
Epithemia turgida	9200
Gomphonema olivaceum	1500
Mastogloia smithii var. *amphicephala*	2400
Navicula reinhardtii	2500
N. scutelloides	2000
N. tuscula	3900
Nitzschia angustata	2500
N. communata	3900

10 000 μ^3 (of large size and quantity)

Cymatopleura solea var. *angulata*	86000
Diploneis domblittensis	10200
Epithemia hyndmanni	47100
Gomphonema intricatum var. *vibrio*	20100
Nitzschia vermicularis	13500
Rhopalodia gibba	31400
Surirella linearis	31400

The list of algal quantity of the transversal sections was compiled according to the method used for calculating phytoplanktonic values (HERODEK and TAMÁS, 1973; 1974; TAMÁS, 1974). The specific name of algae surpassing 0.1 μg wet weight/cm^2 is given, the values of other species is marked with "other" in each of the phyla.

According to the summarized data of algal species noted during the investigation on microphytobenthos in 1965, 1966 and 1967, at transversal sections "M", "K" and "G" in the south-western basin of the lake, with some exceptions, the maxima were observed in June, while in the north-eastern basin the higher values were recorded in May or September—October *(Table 2)*.

The totalled values of algae show two maxima one in June, the other in May. In 1965, however, the maximum was in September at transversal sections "M" and "G" *(Table 3)*.

The quantity of algal phyla and species found in the samples of 1965 are given in *Tables 4—8*, that of 1966 in *Tables 9—13*, while that of 1967 in *Tables 14—18*.

Comparing the number of species, individuals and biomass values *(Table 19)*, we can see that the maximum number of individuals and biomass occurred in May, 1967 at transversal section Balatonalmádi—Balatonvilágos (1 304 individuals and 9.47 μg/cm^2). *Nitzschia sigmoidea* amounted to nearly half of the biomass, while *Cymatopleura elliptica* to a quarter. *Surirella robusta* var. *splendida* and *Stenopterobia pelagica* species were driven down to the bottom mud from the water column due the strong wave-action. The species of small size and volume were comparatively very low in density. The second and third highest values were found in the biomass values of 1967. More than two-thirds of the June value (7.47 μg/cm^2) at transversal section Ságpuszta—Balatonszemes consisted of *Nitzschia sigmoidea* and *Cymatopleura elliptica* the species of small size and volume were in rather low density. The third highest value (6.36 μg/cm^2) was also observed in May, 1967 at transversal section "A" (between Balatonfüred and Zamárdi): one-third consisted of *Cymatopleura elliptica*, one-third of *Nitzschia sigmoidea-Surirella robusta* var. *splendida* and one-third of other species of small size and volume.

The lowest density during the years was always noted in the October (9) samples *(Table 19)*.

Comparing the yearly total wet weight biomass of algae in the openwater bottom mud, we can see that the mean values for 1972 are nearly twice as high as those in the previous years, but three or several times higher values have also been recorded (transversal section "G" 4.6—10.1—39.8 mg/m^2). In 1965 and 1966 the lowest values were at transversal section Ságpuszta—Balatonszemes, while in 1967 a minimum of 32.8 mg/m^2 was noted at transversal section "K".

When comparing the number of individuals and biomass values of phytoplankton in the sixties, the maximum and minimum values do not always

TABLE 2

The number of species of microphytobenthos in Lake Balaton during the 1960s

	M			K			G			A			E		
	1965	1966	1967	1965	1966	1967	1965	1966	1967	1965	1966	1967	1965	1966	1967
IV.			25			19			19			29			19
V.		35	20		33	21		39	20		42	21		47	24
VI.	21	32	21	26	38	24	20	41	30	26	34	28	20	36	19
VII.	11	35	21	15	32	18	19	33	20	26	26	24	18	34	23
VIII.	18	26	20	14	24	26	9	23	28	19	25	23	23	31	23
IX.	11	27	20	10	32	21	12	29	20	26	33	22	29	33	23
X.	14	19	17	12	23	21	13	25	20	14	23	33	13	26	23
XI.		22			21			18			23			15	
Average	15	28	21	15	29	21	15	30	22	22	29	26	21	32	22

TABLE 3

The number of individuals of microphytobenthos in Lake Balaton during the 1960s (i/cm²)

	M			K			G			A			E		
	1965	1966	1967	1965	1966	1967	1965	1966	1967	1965	1966	1967	1965	1966	1967
IV.			669			488			518			469			804
V.		438	894		394	400		188	750		561	930		573	1304
VI.	106	295	520	267	319	806	100	248	895	392	451	679	143	122	273
VII.	130	355	512	384	188	292	142	128	484	519	317	910	375	292	387
VIII.	509	153	293	165	156	463	55	367	971	978	287	490	160	626	413
IX.	1160	525	654	354	245	524	99	200	262	624	334	343	281	224	728
X.	650	432	223	216	115	171	83	121	106	230	306	484	43	134	349
XI.		116			210			92			180			37	
Average	511	331	552	277	232	449	96	192	569	549	348	615	200	287	608

TABLE 4

The biomass of microphytobenthos in Lake Balaton in 1965 between Gyenesdiás and the mouth of River Zala (M) $10^4\mu^3/cm^2$

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
Total	0.5	0.5	0.1	—	—
Euglenophyta	0.1	—	—	—	0.1
Pyrrophyta					
Total	—	—	—	—	—
Chrysophyta					
Amphora ovalis	4.8	3.7	9.5	7.9	13.8
Cymatopleura elliptica	—	60.0	45.0	15.0	—
Gyrosigma distortum var. *parkeri*	—	—	—	—	22.1
Melosira granulata	—	—	126.4	184.9	3.4
M. granulata var. *angustissima*	—	—	4.4	22.5	17.0
Nitzschia sigmoidea	1.4	31.6	1.4	—	1.4
Surirella robusta var. *splendida*	12.5	12.5	—	—	—
Other	7.1	11.3	9.1	11.0	19.4
Total	25.8	119.1	195.8	241.3	77.1
Chlorophyta					
Total	1.3	—	0.4	—	—
Total algae	27.7	119.6	196.3	241.3	77.2

TABLE 5

The biomass of microphytobenthos in Lake Balaton between Szigliget and Balatonmária (K) in 1965 ($10^4\mu^3/cm^2$)

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
Gomphosphaeria lacustris	—	24.8	—	—	—
Other	3.4	0.3	—	0.5	0.4
Total	3.4	25.1	—	0.5	0.4
Euglenophyta					
Total	—	—	6.3	—	—
Chrysophyta					
Amphora ovalis	40.8	6.3	6.3	7.9	28.6
Cymatopleura elliptica	—	135.0	105.0	—	15.0
Melosira granulata	—	—	19.8	74.4	—
Nitzschia sigmoidea	4.1	53.2	5.5	—	8.2
Surirella robusta var. *splendida*	—	50.0	12.5	—	—
Other	21.6	12.9	12.6	10.3	9.7
Total	66.5	257.4	161.7	92.6	61.5
Chlorophyta					
Total	1.4	0.9	—	—	0.3
Total algae	71.3	283.4	168.0	93.1	62.2

TABLE 6

The biomass of microphytobenthos in Lake Balaton between Ságpuszta and Balatonszemes (G) in 1965 ($10^4\mu^3/cm^2$)

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
Total	1.0	12.7	0.5	0.2	0.3
Pyrrophyta					
Ceratium hirundinella	24.4	—	—	—	—
Other	4.5	—	—	—	—
Total	28.9	—	—	—	—
Chrysophyta					
Amphora ovalis	1.6	3.2	1.6	21.0	1.6
Cymatopleura elliptica	—	45.0	—	—	—
Nitzschia sigmoidea	—	1.4	—	4.1	16.5
Surirella robusta var. *splendida*	—	—	—	50.0	—
Other	5.5	12.2	6.4	7.2	8.8
Total	7.1	61.8	8.0	82.3	26.9
Chlorophyta					
Total	0.5	1.0	—	—	—
Total algae	37.5	75.5	8.5	82.5	27.2

TABLE 7

The biomass of microphytobenthos in Lake Balaton between Balatonfüred and Zamárdi in 1965 ($10^4\mu^3/cm^2$)

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
Aphanothece clathrata var. *brevis*	—	10.8	—	—	—
Other	0.9	0.3	0.5	1.6	0.5
Total	0.9	11.1	0.5	1.6	0.5
Euglenophyta					
Euglena oxyuris	135.0	—	—	—	—
Other	—	4.1	—	1.8	—
Total	135.0	4.1	—	1.8	—
Chrysophyta					
Amphora ovalis	98.5	40.8	9.5	45.0	27.0
Cymatopleura elliptica	15.0	45.0	45.0	—	15.0
Diploneis elliptica	38.7	9.2	7.1	6.1	6.1
Fragilaria construens	1.2	1.4	26.5	11.4	3.7
Melosira granulata	—	—	17.6	—	—
Navicula gracilis	9.3	1.8	—	11.9	0.4
Nitzschia sigmoidea	—	53.2	13.7	12.4	13.7
Stauroneis phoenicenteron	—	24.0	—	—	—
Surirella robusta var. *splendida*	37.5	37.5	12.5	—	—
Other	28.1	8.7	12.9	19.5	9.9
Total	228.3	221.6	144.8	106.3	75.8
Chlorophyta					
Total	1.8	2.1	1.5	1.8	—
Total algae	366.0	238.9	146.8	111.5	76.3

TABLE 8

The biomass of microphytobenthos in Lake Balaton between Balatonalmádi and Balatonvilágos (E) in 1965 ($10^4\mu^3/cm^2$)

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
Coelosphaerium kuetzingianum	—	24.8	—	0.6	0.2
Other	1.2	0.5	0.3	0.8	1.2
Total	1.2	25.3	0.3	1.4	1.4
Euglenophyta					
Euglena oxyuris	—	27.9	—	—	—
Other	—	—	1.2	—	—
Total	—	27.9	1.2	—	—
Chrysophyta					
Amphora ovalis	6.3	7.9	5.3	10.6	0.5
Cymatopleura elliptica	45.0	90.0	15.0	60.0	—
C. solea	—	—	25.5	—	—
Diploneis elliptica	1.0	9.2	6.1	10.2	1.0
Gyrosigma distortum var. *parkeri*	0.8	9.8	4.9	13.3	0.8
G. kuetzingii	2.7	—	2.7	23.4	—
Nitzschia sigmoidea	—	42.6	16.5	16.5	4.1
Surirella robusta var. *splendida*	50.0	112.5	187.5	50.0	—
Other	9.1	4.5	19.5	23.7	2.7
Total	114.9	276.5	283.0	207.7	9.1
Chlorophyta					
Total	1.1	4.4	0.6	2.6	0.1
Total algae	117.2	334.1	285.1	211.7	10.6

TABLE 9

The biomass of microphytobenthos in Lake Balaton between Gyenesdiás and the mouth of River Zala (M) in 1966 ($10^4\mu^3/cm^2$)

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
Microcystis flos-aquae	—	10.0	10.0	—	10.0	—	—
Other	0.6	0.4	2.8	0.4	2.1	0.1	0.2
Total	0.6	10.4	12.8	0.4	12.1	0.1	0.2
Euglenophyta							
Total	—	—	—	—	0.2	—	—
Chrysophyta							
Amphora ovalis	11.6	2.6	1.6	2.6	2.6	—	3.2
A. ovalis var. *pediculus*	13.2	0.8	0.5	0.4	0.7	0.1	0.1
Cyclotella bodanica	1.6	2.2	—	0.5	—	13.0	—
Cymatopleura elliptica	30.0	15.0	15.0	45.0	30.0	60.0	30.0
Diploneis elliptica	18.3	4.1	1.0	1.0	1.0	—	1.0
Gyrosigma kuetzingii	21.6	2.7	2.7	7.2	9.9	0.9	1.8
Melosira granulata	24.9	16.3	67.9	15.9	33.1	33.1	5.2
Navicula placentula	12.4	2.3	1.4	1.4	6.9	0.5	1.4
Nitzschia sigmoidea	26.1	28.8	12.3	4.1	12.3	5.5	12.4
Surirella biseriata	—	—	14.1	—	—	—	—
S. robusta var. *splendida*	12.5	12.5	25.0	12.5	12.5	—	12.5
Other	26.4	23.4	22.2	4.1	20.2	21.8	12.5
Total	198.6	110.7	163.7	94.7	129.2	134.9	80.1
Chlorophyta							
Total	0.2	1.3	0.1	0.1	0.1	0.1	0.1
Total algae	199.4	122.4	176.6	95.2	141.6	135.1	80.4

TABLE 10

The biomass of microphytobenthos in Lake Balaton between Szigliget and Balatonmária (K) in 1966 ($10^4\mu^3/cm^2$)

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
Microcystis flos-aquae	—	10.0	—	—	—	—	—
Other	4.1	4.5	3.4	0.1	0.6	0.3	0.4
Total	4.1	14.5	3.4	0.1	0.6	0.3	0.4
Euglenophyta							
Total	10.1	—	9.9	—	0.9	—	—
Pyrrophyta							
Total	—	—	—	—	—	5.3	5.3
Chrysophyta							
Amphora ovalis	17.5	3.2	13.2	15.4	10.6	3.7	6.9
A. ovalis var. *pediculus*	18.5	0.8	0.9	2.8	0.7	0.5	0.8
Cymatopleura elliptica	30.0	45.0	30.0	15.0	75.0	15.0	15.0
Melosira granulata	9.0	21.1	12.9	—	2.1	14.2	17.6
Nitzschia sigmoidea	12.4	28.8	6.9	1.4	26.1	6.9	4.1
Surirella robusta var. *splendida*	—	25.0	12.5	12.5	12.5	—	—
Other	18.0	26.7	10.4	22.6	26.7	3.7	7.3
Total	105.4	150.6	86.8	69.7	153.7	44.0	51.7
Chlorophyta							
Total	—	1.2	0.6	—	2.4	1.1	0.9
Total algae	119.6	166.3	100.7	69.8	157.6	50.7	58.3

TABLE 11

The biomass of microphytobenthos in Lake Balaton between Ságpuszta and Balatonszemes (G) in 1966 ($10^4\mu^3/cm^2$)

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
Mycrocystis flos-aquae	—	10.0	10.0	—	—	—	—
Other	0.8	0.7	0.7	4.3	2.4	0.8	0.4
Total	0.8	10.7	10.7	4.3	2.4	0.8	0.4
Euglenophyta							
Total	14.5	—	—	—	—	4.2	—
Chrysophyta							
Amphora ovalis	5.3	16.4	2.6	7.4	9.5	1.6	3.2
Cymatopleura elliptica	15.0	75.0	15.0	30.0	15.0	—	—
Diploneis elliptica	4.1	29.6	5.1	64.3	9.2	2.0	6.1
D. puella	2.3	4.0	5.2	11.8	2.5	0.1	0.1
Gyrosigma kuetzingii	26.1	0.9	—	1.8	0.9	0.9	0.9
Nitzschia sigmoidea	6.9	20.6	15.1	19.2	23.3	6.9	9.6
Surirella elegans	—	12.0	—	—	—	—	—
S. robusta var. *splendida*	12.5	25.0	12.5	12.5	—	—	—
Other	14.9	7.9	20.1	20.5	60.0	12.8	10.9
Total	87.1	201.4	75.6	167.5	70.4	24.3	30.8
Chlorophyta							
Total	0.6	0.5	0.9	—	1.3	0.1	0.2
Total algae	103.0	212.6	87.2	171.8	74.1	29.4	31.4

TABLE 12

The biomass of microphytobenthos in Lake Balaton between Balatonfüred and Zamárdi (A) in 1966 ($10^4\mu^3/cm^2$)

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
Microcystis flos-aquae	—	—	10.0	—	—	—	—
Other	1.2	1.4	0.9	1.1	2.3	1.9	0.9
Total	1.2	1.4	10.9	1.1	2.3	1.9	0.9
Euglenophyta							
Total	—	—	—	4.2	0.4	—	—
Chrysophyta							
Amphora ovalis	23.8	16.4	2.1	1.6	6.4	3.2	4.8
Campylodiscus noricus var. *hibernica*	—	13.6	1.1	4.5	3.4	1.1	3.4
Cymatopleura elliptica	225.0	75.0	15.0	60.0	30.0	30.0	30.0
Diploneis elliptica	41.8	40.8	47.9	28.6	26.5	7.1	8.2
Gyrosigma attenuatum	—	—	—	21.0	—	—	—
G. distortum var. *parkeri*	81.2	10.7	—	—	0.8	0.8	1.6
G. kuetzingii	63.0	6.3	1.8	4.5	1.8	1.8	1.8
Melosira granulata	2.1	—	8.6	6.4	21.9	9.0	6.4
Nitzschia sigmoidea	57.7	37.1	8.2	1.4	12.4	23.4	6.9
Surirella robusta var. *splendida*	62.5	75.0	12.5	62.5	37.5	50.0	37.5
Other	35.3	32.9	15.3	22.8	21.1	11.3	7.0
Total	592.4	307.8	112.5	213.3	161.8	137.7	107.6
Chlorophyta							
Total	0.4	1.5	0.1	—	2.8	—	—
Total algae	594.0	310.7	123.5	218.6	167.3	139.6	108.5

TABLE 13

The biomass of microphytobenthos in Lake Balaton between Balatonalmádi and Balatonvilágos (E) in 1966 ($10^4\mu^3/cm^2$)

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
Total	2.9	0.4	0.7	1.5	2.2	2.0	0.3
Euglenophyta							
Total	11.5	—	—	—	—	—	—
Chrysophyta							
Amphora ovalis	13.2	2.1	6.4	7.9	11.7	0.5	2.1
Cymatopleura elliptica	60.0	15.0	30.0	210.0	15.0	—	—
Diploneis elliptica	18.4	17.3	22.4	71.4	20.4	9.2	—
D. puella	3.1	0.4	3.0	16.2	2.0	1.1	—
Gyrosigma distortum var. *parkeri*	27.1	3.3	0.8	0.8	0.8	0.8	—
G. kuetzingii	21.6	4.5	18.9	14.4	3.6	8.1	0.9
Melosira granulata	3.4	3.0	11.2	0.8	17.6	6.4	—
Nitzschia sigmoidea	122.3	15.1	27.5	67.3	21.9	4.1	5.5
Surirella biseriata	—	—	14.1	—	—	—	—
S. robusta var. *splendida*	12.5	50.0	62.5	100.0	12.5	—	—
Other	37.3	15.5	28.8	43.6	6.2	8.8	4.4
Total	318.9	126.2	225.0	532.4	111.7	39.0	12.9
Chlorophyta							
Total	5.4	1.3	1.4	0.3	3.4	0.2	0.1
Total algae	338.7	127.9	227.1	534.2	122.6	41.2	13.3

TABLE 14

The biomass of microphytobenthos in Lake Balaton between Gyenesdiás and the mouth of River Zala (M) in 1967 ($10^4\mu^3/cm^2$)

	IV.	V.	VI.	VII.	VIII.	IX.	X.
Cyanophyta							
Total	0.1	—	0.4	0.7	0.1	2.2	7.4
Chrysophyta							
Cocconeis placentula	9.2	24.8	2.8	0.8	10.0	14.8	5.6
Cymatopleura elliptica	135.0	90.0	45.0	120.0	30.0	60.0	—
Diploneis elliptica	9.2	6.1	7.1	1.0	—	16.3	8.1
Gyrosigma attenuatum	—	—	14.0	49.0	—	—	14.0
G. distortum var. *parkeri*	2.4	20.5	—	13.9	18.8	4.9	1.6
G. kuetzingii	7.2	21.6	12.6	9.0	25.2	10.8	15.3
Melosira granulata	35.2	22.8	6.0	—	2.1	—	19.8
Navicula cryptocephala	1.4	1.2	1.6	1.1	0.6	12.9	0.4
Nitzschia amphibia	8.9	18.4	5.7	10.7	3.5	3.7	2.6
N. sigmoidea	180.0	204.7	105.8	180.0	49.4	76.9	20.6
Stenopterobia pelagica	50.5	85.1	9.9	29.7	1.0	4.9	—
Surirella robusta var. *splendida*	—	—	—	100.0	62.5	50.0	12.5
Other	18.2	10.7	18.9	10.6	15.6	16.0	6.9
Total	457.2	505.9	229.4	525.8	218.7	271.2	107.4
Total algae	457.3	505.9	229.8	526.5	218.7	273.4	114.8

TABLE 15

The biomass of microphytobenthos in Lake Balaton between Szigliget and Balatonmária (K) in 1967 ($10^4\mu^3/cm^2$)

	IV.	V.	VI.	VII.	VIII.	IX.	X.
Cyanophyta							
Total	0.4	0.1	1.0	0.1	0.5	—	0.4
Euglenophyta							
Total	0.9	—	—	—	—	—	—
Chrysophyta							
Cymatopleura elliptica	60.0	60.0	75.0	225.0	195.0	105.0	15.0
Diploneis elliptica	2.0	7.1	26.5	1.0	8.1	5.1	2.0
Gyrosigma attenuatum	—	—	—	—	7.0	35.0	—
G. distortum var. *parkeri*	1.6	4.1	—	1.6	15.6	0.8	—
G. kuetzingii	1.8	4.5	12.6	2.7	4.5	4.5	2.7
Melosira granulata	5.6	8.6	3.0	10.7	39.6	15.5	6.4
Nitzschia amphibia	9.4	10.2	9.4	3.1	3.2	10.0	1.7
N. sigmoidea	166.2	87.9	250.1	92.0	50.8	133.3	35.7
Stenopterobia pelagica	8.9	1.9	76.2	18.8	2.0	4.9	—
Surirella robusta var. *splendida*	—	87.5	—	—	62.5	37.5	25.0
S. turgida	—	9.4	3.1	—	18.8	—	—
Other	13.0	6.4	26.0	10.2	17.4	22.6	4.3
Total	268.5	287.6	481.9	365.1	424.5	374.2	92.8
Chlorophyta							
Total	—	—	—	—	—	—	2.2
Total algae	269.8	287.7	482.9	365.2	425.0	374.2	95.4

TABLE 16

The biomass of microphytobenthos in Lake Balaton between Ságpuszta and Balatonszemes (G) in 1967 ($10^4\mu^3/cm^2$)

	IV.	V.	VI.	VII.	VIII.	IX.	X.
Total	0.6	0.6	2.6	0.5	1.7	1.3	1.6
Euglenophyta							
Total	—	—	—	—	—	—	1.0
Chrysophyta							
Amphora ovalis	—	—	25.4	16.4	9.5	1.6	2.1
Cymatopleura elliptica	30.0	90.0	240.0	75.0	105.0	45.0	—
Diploneis elliptica	3.0	9.2	25.6	22.4	4.1	10.2	4.1
Gyrosigma attenuatum	—	—	—	—	56.0	14.0	—
G. distortum var. *parkeri*	5.7	6.5	—	12.3	8.2	0.8	—
Melosira granulata	11.2	9.0	4.3	10.7	15.5	21.9	15.5
Navicula placentula	—	—	17.5	1.4	4.1	2.3	0.4
Nitzschia amphibia	10.2	18.1	12.6	6.1	13.9	5.0	0.8
N. sigmoidea	224.0	218.5	332.5	114.0	357.9	4.1	4.1
Stenopterobia pelagica	36.6	61.4	34.6	12.9	30.7	—	—
Surirella robusta var. *splendida*	—	25.0	12.5	150.0	—	—	—
S. turgida	—	—	15.7	—	3.1	—	—
Other	5.8	17.8	23.4	14.6	61.1	7.8	2.9
Total	326.5	455.5	744.1	435.8	669.4	112.7	29.9
Chlorophyta							
Total	0.1	0.1	0.3	—	4.6	0.1	2.2
Total algae	327.2	456.2	747.0	436.3	675.7	114.1	34.7

TABLE 17

The biomass of microphytobenthos in Lake Balaton between Balatonfüred and Zamárdi (A) in 1967 ($10^4\mu^3/cm^2$)

	IV.	V.	VI.	VII.	VIII.	IX.	X.
Cyanophyta							
Total	0.8	1.6	1.2	2.6	1.6	1.8	3.4
Pyrrophyta							
Total	—	—	—	—	—	—	5.3
Chrysophyta							
Amphora ovalis	2.1	16.9	3.2	1.0	3.2	11.1	2.6
Campylodiscus noricus var. *hibernica*	11.3	12.4	—	—	13.5	1.1	10.2
Cymatopleura elliptica	90.0	210.0	45.0	345.0	60.0	45.0	15.0
Diploneis elliptica	37.7	22.4	22.4	6.1	24.5	9.2	2.0
Fragilaria construens	4.5	8.4	8.9	21.5	2.2	0.8	1.6
Gyrosigma attenuatum	21.0	—	—	—	—	7.0	7.0
G. kuetzingii	5.4	10.8	13.5	10.8	15.3	0.9	22.5
Melosira granulata	11.2	21.9	33.1	4.3	77.4	48.6	33.1
Nitzschia amphibia	3.1	10.7	4.1	5.3	2.0	3.1	2.4
N. sigmoidea	77.0	175.9	97.5	72.8	17.8	31.6	49.5
Stenopterobia pelagica	1.0	11.9	3.0	7.9	—	—	2.0
Surirella elegans	12.0	—	—	—	—	—	—
S. robusta var. *splendida*	12.5	112.5	37.5	37.5	62.5	—	100.0
S. turgida	—	—	3.1	6.3	—	—	3.1
Other	21.3	20.8	11.9	22.0	7.9	8.8	26.2
Total	310.1	634.6	283.2	540.5	289.3	167.2	277.2
Chlorophyta							
Total	0.6	—	1.2	0.7	0.1	0.2	—
Total algae	311.5	636.2	285.6	543.8	291.0	169.2	285.9

TABLE 18

The biomass of microphytobenthos in Lake Balaton between Balatonalmádi and Balatonvilágos (E) in 1967 ($10^4 \mu^3/cm^2$)

	IV.	V.	VI.	VII.	VIII.	IX.	X.
Cyanophyta							
Total	1.0	1.4	1.5	0.9	1.1	3.2	3.8
Chrysophyta							
Amphora ovalis	2.6	10.1	2.6	4.8	6.3	7.4	2.6
Campylodiscus noricus var. *hibernica*	10.2	10.1	—	3.4	19.2	—	15.8
Cymatopleura elliptica	60.0	225.0	60.0	165.0	135.0	45.0	45.0
Diploneis elliptica	51.0	42.8	5.1	10.2	10.2	70.4	5.1
D. puella	7.0	15.3	—	2.5	1.8	12.3	0.4
Gyrosigma distortum var. *parkeri*	13.1	27.9	—	16.4	6.5	—	—
G. kuetzingii	—	29.2	12.6	9.0	4.5	3.6	21.6
Melosira granulata	28.8	6.4	14.2	4.3	61.9	59.8	53.3
Nitzschia amphibia	14.9	21.8	4.2	6.6	4.3	11.4	2.3
N. sigmoidea	346.2	438.3	63.2	63.2	35.7	90.7	28.8
Stenopterobia pelagica	4.0	21.8	—	8.9	—	1.0	—
Surirella robusta var. *splendida*	37.5	75.0	62.5	37.5	75.0	12.5	—
Other	9.6	22.2	5.5	20.7	6.7	26.5	3.1
Total	584.9	945.9	229.9	352.5	367.1	340.6	178.0
Chlorophyta							
Total	—	0.1	—	1.3	—	0.6	4.4
Total algae	584.9	947.4	231.4	354.7	368.2	344.4	186.2

occur at the same transversal section and at the same time. The phytoplanktonic and microphytobenthic population changes monthly and yearly according to regions, thus a sequence of different species may be established.

Summary

The author carried out qualitative and quantitative investigations on the horizontal microphytobenthos in 1965, 1966 and 1967.

In 1967 the maximum number of individuals was 1304 i/cm², that of biomass 9.47 μg/cm². Nearly half of the biomass comprised *Nitzschia sigmoidea*

TABLE 19

The biomass change of microphytobenthos in Lake

	M			K		
	1965	1966	1967	1965	1966	1967
IV.			45.7			26.9
V.		19.9	50.5		11.9	28.7
VI.	2.8	12.2	22.9	7.1	16.6	48.2
VII.	12.0	17.6	52.6	28.3	10.0	36.5
VIII.	19.6	9.5	21.8	16.8	6.9	42.5
IX.	24.1	14.1	27.3	9.3	15.7	37.4
X.	7.7	13.5	11.4	6.2	5.0	9.5
XI.		8.0			5.8	
Average	13.2	13.5	33.2	13.5	10.3	32.8

and a quarter of *Cymatopleura elliptica*. The species of small size and volume yielded very low values. In May, the biomass value at transversal section Ságpuszta—Balatonszemes was 7.47 $\mu g/cm^2$, while between Balatonfüred and Zamárdi 6.32 $\mu g/cm^2$. At both places, the diatoms of large size and volume were represented in considerable quantities.

During the years investigated the author noted nine lowest biomass values on the basis of samples taken in October.

Comparing the 1967 mean biomass values they are two, three or several times higher than those in the previous years.

In 1965 and 1966 the lowest mean values were measured between Ságpuszta and Balatonszemes (4.6 and 10.1 mg/m^2), while the average minimum in 1967 (32.8 mg/m^2) was observed at transversal section "K", between Szigliget and Balatonmária.

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Balaton in the 1960s (mg wet weight/m^2)

G			A			E		
1965	1966	1967	1965	1966	1967	1965	1966	1967
		32.7			31.1			58.5
	10.3	45.6		59.4	63.6		33.8	94.7
3.7	21.2	74.7	36.6	31.0	28.5	11.7	12.7	23.1
7.5	8.7	43.6	23.8	12.3	54.3	33.4	22.7	35.4
0.8	17.1	67.5	14.6	21.8	29.1	28.5	53.4	36.8
8.2	7.4	11.4	11.1	16.7	16.9	21.1	12.2	34.4
2.7	2.9	3.4	7.6	13.9	28.5	1.0	4.1	18.6
	3.1			10.8			1.3	
4.6	10.1	39.8	18.5	23.7	36.0	19.1	20.0	43.0

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A BALATON MIKROFITOBENTOSZÁNAK BIOMASSZA VÁLTOZÁSA A HATVANAS ÉVEKBEN

Tamás Gizella

Összefoglalás

Szerző az 1965, 1966 és 1967 évi horizontális mikrofitobentosz minőségi és mennyiségi vizsgálatát végezte el.

Az egyedszám és biomassza maximum 1967 év májusában cm^2-re 1304 egyed és 9,47 $\mu g/cm^2$. A biomasszának csaknem felét a *Nitzschia sigmoidea*, negyedrészét pedig az ugyancsak nagytestű és térfogatú *Cymatopleura elliptica* tette ki. A kis termettel és tömeggel biró fajok csak igen alacsony értékkel szerepeltek ebben az együttesben. Ságpuszta—Balatonszemes 1967 év júniusi értéke 7,47 $\mu g/cm^2$, az ez év májusi Balatonfüred—Zamárdi szelvényen 6,32 $\mu g/cm^2$. Mindkét együttesben a nagytermetű és térfogatú kovamoszatok voltak jelentős mértékben képviselve.

A vizsgálati évek 9 legalacsonyabb biomassza számait az októberi mintákból jegyezte fel.

A biomassza értékek átlagait összevetve az 1967 éviek helyenként mintegy két-, három- vagy még többszöröse az előző évekének.

Az 1965 és 1966 évben a legalacsonyabb átlagokat a Ságpuszta—Balatonszemes harántszelvényen 4,6 és 10,1 mg/m^2, míg az 1967 évi átlag minimum a K szelvényen Szigliget—Balatonmária térségében 32,8 mg/m^2 volt.