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CHARACTERISTIC PHYTOPLANKTON COMMUNITIES IN THE DAMMED UP SECTION OF THE TISZA RIVER AND IN THE EASTERN MAIN CANAL

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Abstract

Studies on the dammed up section of Tisza at Tiszalök and on the Eastern Main Canal revealed that the quantitative composition of phytoplankton was essentially different between consecutive years, exhibiting changes even within the same year. It often occurred that in a few weeks such phytoplankton communities appeared in the water which were practically different from the previous one. It emerged the question as to which phytoplankton communities appearing temporarily in similar composition are characteristic of the above mentioned waters.

To settle this question, the constancies (C) of taxons in the single samples were determined. The results of examinations at each given sampling place and in each given period were regarded as a community survey.

The analyses showed that from 1968 to 1979 phytoplankton communities in the dammed up section of the Tisza at Tiszalök and in the Eastern Main Canal could be ranged into the same basic type in periods of mass vegetation. The constant and dominant presence of *Stephanodiscus hantzschii* GRUN. and the constant presence of some species of the order Chlorococcales were characteristic of this type. Some sub-types of this basic mass vegetation type were also observed.

Introduction

According to HUTCHINSON (1967) the phytoplankton community observed in a particular time of sampling should be regarded as an association, and named after the dominant species (this applies to the phytoplankton of lakes). In connection with that a program was proposed by FELFÖLDY (1981) for future investigations: "Besides recognition, delimitation and systematization such elementary questions should also be settled by the investigators of phytoplankton whether communities occurring in the same place but changing seasonally should be regarded as associations according to seasons each or only the change of aspect of the same association". Concerning the plankton communities of rivers he claims that we know so little of them that we cannot even try to systematize them.

In Hungary UHERKOVICH described such phytoplankton communities in the Tisza, which he regarded as typical ones. Such were the mass vegetations characterized by the dominance of *Melosira granulata* var. *angustissima* MÜLL. — *M. granulata* var. *angustissima* f. *spiralis* HUST., resp. *Cyclotella — Nitzschia actinastroides* (LEMM.) v. GOOR, and *Cyclotella — Aphanizomenon flos-aquae* (L.) RALFS (UHERKOVICH 1968 a, b, 1969 a, 1971). On the basis of comparison with other streams he claims that the general phytoplankton of the Tisza is a *Cyclotella — Nitzschia aci-*

cularis W. SMITH — *Synedra ulna* (NITZSCH.) EHRBG. — *Scenedesmus* community, that of the Danube a *Cyclotella* — *Nitzschia acicularis* W. SMITH — *Synedra acus* KÜTZ. — *Actinastrum Hantzschii* LAGH. community, and that of the Drava a *Ceratoneis arcus* KÜTZ. — *Cyclotella* — *Diatoma vulgare* BORY — *Synedra ulna* (NITZSCH.) EHRBG. one (UHERKOVICH 1969 b, 1971).

Sampling and Methods

The Eastern Main Canal is a canal led out from the reservoir of the river barrage of Tiszalök. Its water flow is regulated with sluices, its flow volume in irrigation periods is 35—40 m^3/sec, the width of its water surface 40 m, its depth 3—4 m, its length 98 km (Fig. 1).

Places of water sampling were: 1 — Tiszalök (0.4 riv km), 2 — Tiszavasvári (4.7 riv km), 3 — Balmazújváros (44.5 riv km). From 1968 to 1975, water samples were taken weekly, from 1976 to 1979 on occasions from the Eastern Main Canal from below the water surface, from the main current. Care was taken to collect the samples from the same mass of water (UHERKOVICH 1968 b). Therefore, by taking into accout the actual flow rate of water, the water of the canal at Balmazújváros was sampled 2—7 days later relative to the samplings at Tiszalök, Tiszavasvári.

The quantitative examination of phytoplankton communities was made by Utermöhl's method (UTERMÖHL 1958). The characteristic phytoplankton communities were separated from one another on the basis of the constancies of species. Constancies were interpreted according to KÁRPÁTI and TERPÓ (1971), as follows: The results of examinations on samples from each point of sampling in the Eastern Main Canal and collected in the single periods were regarded as a community survey, and these were compared. The degree of constancy shows in which percentage a particular taxon occurred in the samples:

5 = 81 – 100 %
4 = 61 – 80 %
3 = 41 – 60 %
2 = 21 – 40 %
1 = 1 – 20 %

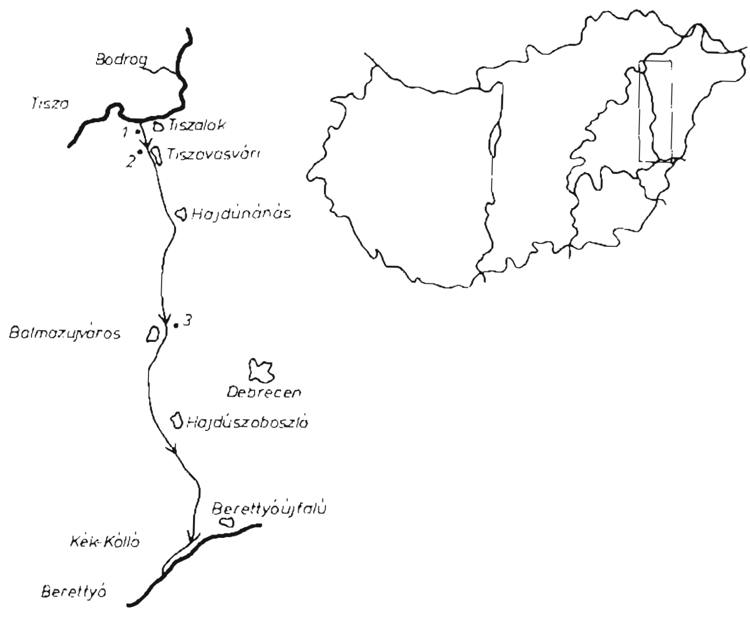

Fig. 1. Sketchy map of Hungary and the Eastern Main Canal.

Results

The quantitative phytoplankton studies carried out for many years in the dammed up reach of the Tisza at Tiszalök and in the Eastern Main Canal shoved that under suitable ecological conditions the density of phytoplankton communities could be as high as several million individuals per liter. If the Tisza was not flooding, the velocity of water flow in the Eastern Main Canal was little, the suspended mineral materials settled out, and the water became transparent. With the developing of a favourable light climate in the water the growth rate of phytoplankton organisms increased rapidly. Since in the Tisza and in the Eastern Main Canal the water was amply supplied with plant nutrients, there was no nutrient limitation. Temperature did not essentially influence the quantitative composition of phytoplankton communities, and mass vegetations could develop within a few days.

As soon as the ice began to melt, opportunity was offered for the developing of phytoplankton mass vegetation. In such times *Stephanodiscus hantzschii* GRUN. dominated in the phytoplankton. The individual numbers of other species were insignificant. Such a mass vegetation was observed on one occasion in the dammed up reach of the Tisza at Tiszalök in the first days of February, 1972 (for more details see KISS, K. T. 1975). Similar mass vegetations developed, however, each year in the Balmazújváros section of the Eastern Main Canal. To exemplify this, the quantitative data of the mass vegetation of March 9, 1979 are presented in Table 1.

In high-water periods during spring and early summer, individual numbers were small in the phytoplankton of the Tisza and in the Eastern Main Canal (100—500 thousand ind./lit). From the end of May to the end of October, besides the slow flow rate of water in flood-devoid periods, and favourable light conditions mass vegetation of plankton algae occurred more than once in one year (see for details: KISS, K. T. 1974 a, b, KISS, K. T. and SZABÓ 1975). Examples are presented in Table 1 for the illustration of phytoplankton communities of high individual and species number.

The phytoplankton mass vegetations of consecutive years showed essential differences in regard of their quantitative composition (individual numbers ranged from 1—2 million to 20—21 million in one liter water). Because of that they often appeared completely different and difficult to compare.

Though the plankton algal communities of mass vegetations exhibited essential differences quantitatively, they were fairly similar in respect of species composition. In the comparison of phytoplankton communities the frequency of a species determined on the basis of its constancy values is thought to be more essential than the individual number per liter of the particular species.

104 phytoplankton communities were analyzed for constancy. On the basis of their dominant species, these communities were ranged into four groups. In each group 27, 27, 15 resp. 35 samples were analyzed (Table 2).

Values for constancy showed that during these studies phytoplankton mass vegetation in the dammed up section of the Tisza at Tiszalök and in the Eastern Main Canal was of the same type in respect of its basic properties. This phytoplankton community was characterized by the dominance of *Stephanodiscus hantzschii* GRUN. (constancy 5) and the appearance of some species (with a constancy of 3—5 each) of the order Chlorococcales (column 1, Table 2). In the algal group with 3—5 constancy, there were 5 diatoms and 24 taxa belonging to Chlorococcales. This phytoplankton community was regarded as the basic type of the mass vegetation during

Table 2. *Constancies of species of phytoplankton mass vegetation types*

Type of mass vegetation	S—Ch	S-Ch-N	S-Ch-A	S
Number of analysed samples	27	27	15	35
Stephanodiscus hatzschii GRUN.	5	5	5	5
Ankistrodesmus acicularis (A. BR.) KORS	5	4	2	2
A. angustus BERN.	5	5	5	3
Chlorella vulgaris BEIJER	5	4	3	2
Oocystis borgei SNOW.	5	4	3	1
Scenedesmus quadricauda CHOD.	5	5	4	1
Cyclotella Kuetzingiana THWAITES	4	4	4	1
C. meneghiniana KÜTZ.	4	4	3	1
Nitzschia acicularis W. SMITH	4	3	4	2
Actinastrum hantzschii LAG.	4	3	3	1
Ankistrodesmus longissimus var. *acicularis* (CHOD.) BRUNNT.	4	2	3	3
Crucigenia terapedia (KIRCH) W. et G. S. WEST	4	4	5	1
Didymocystis planctonica KORS.	4	3	4	
Nephrochlamys subsolitaria (G. S. WEST) KORS.	4	3	2	
Scenedesmus acuminatus (LAG.) CHOD.	4	3	3	
S. acutus MEYEN	4	2	2	
Tetrastrum glabrum (ROLL) AHLSTR. et TIFF.	4	2	3	1
Nitzschia actinastroides (LEMM.) v. GOOR	3	5	3	
Ankistrodesmus arcuatus KORS.	3	2	2	
A. minutissimus KORS.	3	3	3	1
Coelastrum microporum NAEG.	3	2	3	1
Crucigenia apiculata (LEMM.) SCHMIDLE	3	2	4	
Dictyosphaerium pulchellum WOOD	3	2	2	
Didymocystis tuberculata KORS.	3	1	2	
Kirchneriella lunaris (KIRCH.) MÖB.	3	3	3	1
Scenedesmus intermedius CHOD.	3	3	2	1
Schroederia setigera (SCHROED.) LEMM.	3	1	1	1
Tetrastrum staurogeniaeforme (SCHROED.) LEMM.	3	1	1	
Treubaria triappendiculata BERN.	3	1	1	
Melosira granulata var. *angustissima* MÜLL.	2	3	3	
Micractinium pusillum TRES.	2	3	2	
Asterionella formosa HASS.	1	1	3	3
Aphanizomenon flos-aquae (L.) RALFS	1	1	5	

Explanation: S—Ch — *Stephanodiscus hantzschii* GRUN. — *Chlorococcales* S—Ch—N — *Stephanodiscus hantzschii* GRUN. — *Chlorococcales* — *Nitzschia actinastroides* (LEMM.) v. GOOR, S—Ch—A — *Stephanodiscus hantzschii* GRUN. — *Chlorococcales* — *Aphanizomenon flos-aquae* (L.) RALFS, S — Mass vegetation with the dominance of *Stephanodiscus hantzschii* GRUN. In the table those species are listed which posses at least a constancy of 3 in some mass vegetation type.

these studies. It was temporarily replaced by one of its subtypes, which were the following ones:

1. Phytoplankton community of which the presence of *Stephanodiscus hantzschii* GRUN. — *Chlorococcales* — *Nitzschia actinastroides* (LEMM.) v. GORR was characteristic. The main features of this phytoplankton mass vegetation and those of the basic type were the same. However, the individual numbers of *Nitzschia actinastroides* (LEMM.) v. GORR were occasionally of the order of a million making up 70—80% of the phytoplankton.

2. A phytoplankton community of which the constant presence of *Stephanodiscus hantzschii* GRUN. — *Chlorococcales* — *Aphanizomenon flos-aquae* (L.) RALFS was characteristic. In the basic type of the mass vegetation the constancy of *Aphanizo-*

menon flos-aquae (L.) RALFS was 1., its individual number being of the order of thousand, ten thousand per liter. In certain times, particularly in late summer, constancy values increased to 5, individual numbers even attaining the order of 100 000, moreover the number of trichomes increased to 1.000,000 lit^{-1}. It became a dominant member of the phytoplankton.

3. A phytoplankton community characterizable by the constant presence of *Stephanodiscus hantzschii* GRUN. The mass vegetation in late winter and early spring was very similar to the aforementioned basic type in that the constancy of *Stephanodiscus hantzschii* GRUN was 5. Its individual number was of the order of a million. It was dominant member of the phytoplankton. Beside it with lower constancy values and smaller individual numbers several taxa characteristic of the basic type also occurred.

The transition between the basic type and the three subtypes each was continuous. Species frequently appearing in the samples often occurred in great numbers and became perhaps dominant. Constancies were however even then similar to those of the basic type. Phytoplankton communities occurring in the dammed up section of the Tisza at Tiszalök and in the Eastern Main Canal in great individual numbers are not regarded as associations, or the varieties of their aspect. Further studies are necessary to decide whether the concepts association, aspect can be also used in the case of the phytoplankton communities of rivers. The characteristic phytoplankton mass vegetations which develop, occur and float away in the above streams, and which are made up of euplanktonic algae are considered to be and are named plankton algal communities of similar constancy.

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Jellegzetes fitoplankton együttesek a Tiszán és a Keleti Főcsatornán

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Kivonat

A Tisza tiszalöki visszaduzzasztott mederszakasza és a Keleti Főcsatorna planktonalga vizsgálata során szembetűnő, hogy az egymást követő években s egy éven belül is a fitoplankton mennyiségi viszonyai jelentősen különböznek egymástól. Gyakran néhány héten belül is, szinte merőben eltérő planktonalga együttesek jelennek meg a vízben. Felvetődik a kérdés, hogy vannak-saját jellegzetes, időszakonként hasonló összetételű fitoplankton együttesei a fenti folyóvizeknek vagy nincsenek?

Az elemzéseket követően megállapítható volt, hogy 1968—79 között a Tisza tiszalöki, visszaduzzasztott mederszakaszának és a Keleti Főcsatornának fitoplankton együttesei, a tömeg *Stephanodiscus hantzschii* Grun. konstans és domináns, valamint a Chlorococcales rend egyes fajainak konstans jelenléte jellemző. Ennek a tömegvegetáció alaptípusnak bizonyos altípusai is megfigyelhetők.

Karakteristične fitoplanktonske zajednice Tise i Istočnog glavnog kanala

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Abstrakt

Pri istraživanjime planktonskih algi u akumulaciji reke Tise i Istočnog glavnog kanala kod Tiszalök-a, uočljivo je da se kvantitativni odnosi fitoplanktona, kako iz godine u godinu, tako i u toku jedne godine znatno razlikuju. Često i u toku nekoliko nedelja dolazi do pojave veoma različitih fitoplanktinskih zajednica. Postavlja se pitanje, postoje li svojstvene i specifične, i po sastavu sezonski slične fitoplanktonske zajednice u navedenim tekućim vodama, ili ne?

Na osnovu izvršsenih analiza utvrdjeno je da u periodu 1968—1979. godine fitoplanktonske zajednice u naznačenom regionu Tise i Istočnog glavnog kanala, u toku njihove masovne pojave, spadaju u isti osnovni tip. Ovo karakteriše konstantno i dominantno prisustvo Stephanodiscus hantzschii Grun., a takodje i konstantno prisustvo odredjenih vrsta iz reda Chlorococcales. Takodje su uočene unutar osnovnog tipa masovne fitoplanktonske vegetacije i postokanje odredjenih podtipova.

ХАРАКТЕРНЫЕ ФИТОПЛАНКТОННЫЕ ГРУППЫ НА ТИССЕ И НА ВОСТОЧНОМ ГЛАВНОМ КАНАЛЕ

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В ходе исследования планктонных водорослей в запружённом участке русла Тиссы у Тиссалёка и Восточного главного канала обращает на себя внимание тот факт, что количественные отношения фитопланктона значительно отличаются друг от друга не только из года в год, но и в течение одного года. Часто даже в течение нескольких недель в воде наблюдаются почти совершенно различные группы планктонных водорослей. Возникает вопрос: существуют ли характерные, свойственные указанным выше текучим водам периодически сходные группы фитопланктона?

Анализы подтвердили, что группы фитопланктона в запружённом участке русла Тиссы и Восточного главного канала в период между 1968—1979 годами характеризируются массовым и константным доминантны и наличием S t e p h a n o d i s c u s hantzschii Grun. а также константным наличием некоторых пород отряда Chlorococcales. Кроме того наблюдаются некоторые подтипы этой основной массовой вегетации.

Table 1. *Quantitative relations of phytoplankton in periods of characteristic mass vegetation*

Place of sampling	1	2	3	1	2	3	1	2	3	3
	1972			1972			1975			1979
Time of sampling	7.6	7.6	9. 6	21. 6	21. 6	23. 6	10. 9	10. 9	12. 9	9. 3
Achnantes minutissima KÜTZ.										25
Asterionella formosa HASS.								25	5	25
Cyclotella kuetzingiana THWAITES	650	610	360	25	20	30	50	65	20	
C. meneghiniana KÜTZ.	800	810	550	10	15	25	95	110	25	320
Melosira distans (EHRBG.) KÜTZ.	45	50	10				10	10	5	
M. granulata var. *angustissima* MÜLL.						12		25	20	
Nitzschia acicularis W. SMITH	900	550	325	50	40	225	63	50	50	
N. actinastroides (LEMN.) v. GOOR	25	25	75	1225	1200	1200				
Stephanodiscus hantzschii GRUN.	16,200	13,830	3080	330	180	395	1120	1925	480	9,055
Surirella ovata KÜTZ.										25
Synedra acus KÜTZ.			75				12			
S. ulna (NITZSCH.) EHRBG.					12			12	15	
Pennaies spp.		100	120	15	63	38		13	95	75
Bacillariophyceae:	18,620	15,975	4595	1655	1530	1925	1350	2235	715	10,225
Actinastrum hantzschii LAG.	75	75	325				15	50	10	
Ankistrodesmus acicularis (A. BR.) KORS.	100	125	75		12			10		
A. angustus BERN.	600	500	1025	288	238	400	10	50	20	10
A. arcuatus KORS							15			
A. longissimus var. *acicularis* (CHOD.) BRUNNT.	150	150	175						5	75
A. minutissimus KORS.								10		
Chlorella vulgaris BEIJER.	195	220	200	70	85	125				75
Chodatella quadriseta LEMM.			25							
Coelastrum microporum NAEG.	25	50	100		12	38				
C. sphaericum NAEG.				12	13	12		10		
Crucigenia tetrapedia (KIRCH.) W. et G. S. WEST					12	12	175	115	20	
Dictyosphaerium pulchellum WOOD	175	150	125			13				
Didymocystis planctonica KORS.	25	25		25	25	38				
D. tuberculata KORS.		25		12	38					
Kirchneriella lunaris (KIRCH.) MÖB.	25	50	50	38	140	300	25	10	5	
K. obesa (W. West) SCHMIDLE	15	15	10	20	40	45				
Micractinium pusillum TRES.			25							
Nephrochlamys subsolitaria (G. S. WEST) KORS.	10	10	15	18	22	43				
Oocystis borgei SNOW.	50			12	13	12		15		
Pediastrum boryanum (TURP.) MENEGH.							40	50		
P. tetras (EHRBG.) RALFS						12				
Scenedesmus acuminatus (LAG.) CHOD.	300	300	50					5		
S. acutus MEYEN	200	50	25						10	
S. ecornis (RALFS) CHOD.	25	25								
S. intermedius CHOD.	100		25	12	12					
S. opoliensis P. RICHT.					13					
S. quadricauda CHOD.	150	225	100	300	75	75		15		
S. spinosus CHOD.	25	50	10	45	10		15	15		
Scenedesmus spp. :	50	50	15	20	50	50	45	50	5	
Schroederia setigera (SCHROED.) LEMM.		75								10
Tetraedron caudatum (CORDA) HANSG.		25				12				
T. incus (TEIL.) G. M. SMITH		25	50	20		13				
T. minimum (A. BR.) HANSG.			50				5		5	
T. muticum (A. BR.) HANSG.	25		75		12					
Tetrastrum glabrum (ROLL) AHLSTR. et TIFF.		25	50	12	13	50	25	65		
T. staurogeniaeforme (SCHROED.) LEMM.				13	13		25	35	5	
Treubaria triappendiculata BERN.	50	25	50	12	12					
Chlorococcales spp.	130	180	75	21	65	100	15		10	75
Chlorococcales:	2,500	2,450	2725	950	925	1350	410	505	95	245
Aphanizomenon flos-aquae (L.) RALFS							675	200		
Merismopedia glauca (EHRBG.) NAEG.	10									
Microcystis flos-aquae (WITTR.) KIRCH.		20	25							
Cyanophyta spp.	75	75				38	25			
Euglena spp.			10		12	12	50	75		
Strombomonas fluviatilis (LEMM.) DEFL.	5			15			40	15		
Trachelomonas volvocina EHRBG.					13					20
Chroomonas acuta UTERM.							10		5	25
Cryptomonas erosa EHRBG.							20		10	75
C. marssonii SKUJA										20
C. ovata EHRBG.							55	15	20	
Peridium sp.					15					
Dinobryon sertularia EHRBG.			25							
Mallomonas sp.										20
Chlamydomonas spp.	150	50	25		35	15		25		330
Staurastrum paradoxum MEYEN								15		
Total number of algae in ind./lit.	21,360	18,570	7405	2620	2530	3340	2635	3085	845	10,960