ALGOLOGICAL STUDIES OF THE MAROS (MUREŞ) RIVER

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Introduction

Algae play an important role in riverine ecosystems: they produce oxygen, serve as food for animals, and indicate conditions of and changes to the environment.

At points near the source and upper sections of rivers, attached algae (periphyton) are subsurface as inhabitants of the planktonic environment (pseudoplankton, tychoplankton). Due to both the high velocity of water flow in upper sections of river basins, and high turbidity caused by inorganic particles, diatoms are the main group of algae. A decrease in velocity and/or increasing nutrient load can lead to the dominance of other groups (e.g. green algae) of algae. In the middle and lower sections of rivers real planktonic algae (potamoplankton) can become increasingly dominant.

The first records on algae in the Maros River were provided by Schaarschmidt (1880). Lepşi (1925-26) studied the plankton of the river at Orăştie, and recorded 13 species. Péterfi and Róbert (1958) described two new species of Cymbella (Cymbella subcapitata and Cymbella semielliptica) from samples that were taken at Tîrgu Mureş. Róbert (1960, 1962), specialist in diatomology, studied the diatoms of the closely connected Tîrgu Mureş backwater between 1960-62. In this backwater an interesting mixture of diatoms that are characteristic for different habitats was found: the planktonic Melosira granulata var. angustissima, the epiphytic Synedra parasitica var. subconstricta and Nitzschia sigmoidea, the alpin-boreal Pinnularia karelica, the rheophyl Ceratoneis arcus and Surirella tenerea var. nervosa and the halophyl Cyclotella meneghiniana, Epithemia sorex, Bacillaria paradoxa and Nitzschia hungarica. He considered most of the species of the identified 92 to be ubiquists. Róbert (1962) described two new taxa from this backwater (Pinnularia interrupta W.Sm. var. intermedia Róbert and Gomphonema augur Ehr. var. marisiensis Róbert). Róbert (1968) studied the diatoms in samples taken from the Maros river at Tîrgu Mureş in 1953.

Diatoms found in the phytobenthos (the term bioderma used in the cited paper) had rheophyl, bentonic, eutrophic and b-mesosaprobic indication values. He characterized the species as having pseudoplanktonic elements; and numerous diatoms had their origin in the saline waters nearby (Sîngiorgiu de Mureş).

Uherkovich (1971) took samples in 1962 and in 1967 at the mouth of the Maros near Szeged. Rheon-type diatoms dominated, characteristic potamoplankton was not observed even when the water level was low. The total number of individuals (1.8-4.8 x 10^6 individuum/l) was higher than that in the Tisza River. The presence of Cyclotella meneghiniana, Nitzschia acicularis and Nitzschia palea among the dominating species indicated a high level of pollution. He concluded that although the Mures has a detectable influence on the Tisza, this is not of considerable significance.

Ádámosi et al. (1978) analyzed the algae of the river along a longitudinal section in 1977. Their conclusion was that the phytoplankton which indicate a high level of pollution and hypertophic conditions have an essential influence on the Tisza River. A significantly increased number of euplanktonic diatoms and green algae was found.

Dobler & Kovács (1981) analyzed the diatoms in the benthos of the Maros River at the mouth. The eu-politrophic indicator Cyclotella pseudostelligera, the planktonic Skeletonema potamos and Nitzschia acicularis, which can be found in polluted waters, were the dominants. The Maros had a considerable influence on the benthic diatom assemblages of the Tisza River.

Váncsa (1981) analyzed the other group of algae in parallel samples of the above survey. His conclusion was that the impact of the Maros on the Tisza is the highest among all the tributaries.

Hamar (1991) established that the phytoplankton of the Maros River is characterized by the dominance of μ-algae (2-3 μ) during the vegetation period. Also, either green algae or Cyclotella meneghiniana can be subdominants. When the total number of algae exceeds 100 x 10^6 individuum/l. the water is slightly polluted and politrophic. Impact on the Tisza River is considerable.

Material and methods

Samples were taken on 15 sampling sites during a longitudinal sampling trip along the Maros in August 1991. Samples were fixed in Lugol's Iodine. Algae were counted under an inverted microscope. An Olympus type microscope was used in identifications.

Results

Species composition (fig. 1.)
In this study 159 taxa of algae were found in Mures:

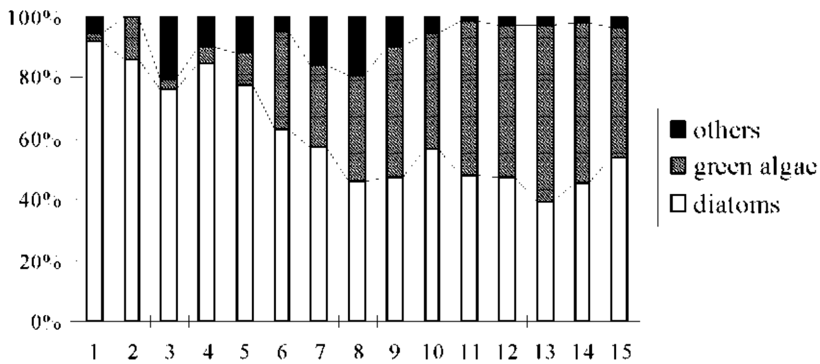
Cyanophyta	10
Euglenophyta	14
Pyrrophyta	7
Chrycophyceae	6
Bacillariophyceae	46
Chlorophyceae	76
Total	159

Cyanophyta

Blue-green algae are sporadic in upper sections of the river. In the middle and upper sections three species, Oscillatoria limnetica Lemm., Phormidium molle (Kutz.) Gom. and

Spirulina laxissima G.S. West are characteristic. All the three planktonic elements can occur in polluted and saline waters. Phormidium molle is saprophytic.

Fig.1. Percentage composition of algal communities



Euglenophyta

Algae belonging to this group are sporadic in the upper and middle sections. Below Alba Iulia species (Euglena polymorpha Dang., Euglena proxima Dang., Euglena viridis Ehr.) indicating polluted conditions appear. The record of Petalomonas involuta Skuja is interesting.

Pyrrophyta

They are rare in the upper section, Rhodomonas lacustris Pasch. et Rutt. and Cryptomonas species are frequently found in lower sections of the river.

Chrysophyceae

Their occurence is sporadic all along the river basin.

Bacillariophyceae

The upper section is characterized by rheophyl elements, although the number of species that are occuring mostly in streams (like Achnanthes minutissima v.minutisima Kutz., Meridion circulare Ag., Nitzschia fonticola Grun.) is rather low. Species indicating eutrophic conditions or modetately polluted environments appear next below the source (Nitzschia acicularis (Kutz.) W.Sm., Navicula cryptocephala Kutz.). Nitzschia palea (Kutz.) W.Sm. is also characteristic in the upper region. Ecological qualification of diatoms lies in a wide range in this river section: oligotrophic and eutrophic, oligosaprobic and a-mesosaprobic indicators are present, they are mostly cosmopolitan. In the midstream section Cyclotella meneghiniana Kutz., Nitzschia palea (Kutz.) W.Sm., Nitzschia acicularis (Kutz.)W.Sm. and Nitzschia palacea Grun. are constant elements. These species indicate eutrophic conditions and polluted environments. Planktonic diatoms appear in this section like Aulacoseira distans (ERhr.) Simon., Acanthoceras zachariaschii (Brun.)Simon.; and Nitzschia reversa W.Sm. which indicate saline waters. The lower section is similar to the midstream one with more planktonic diatoms like Aulacoseira granulata var. angustissima (O.F. M.) Simon.and Skeletonema potamos (Weber) Hasle.

Chlorophyta

Green algae are practically absent in the upper section. A large number of green algae can be found in the middle section, most of them are cosmopolitan and occur in eutrophic waters. Carteria wisconsinense H.P. is a rarity, and occurs in planktonic lakes. The number of taxa increases from the upper section, algae belonging to Chlorococcales dominate. A small sized (2-3 µm) coccoid green alga appears in this region. µ-algae invasion has began some years ago in small eutrophic streams, canals and backwaters are found in larger quantities and recently in rivers too. This coccoid green alga regularly occurs in the Maros River in summer (Hamar 1991). Several rare species, like Chlorogonium elegans (Dang.) Dang., Micractinium crassisetum Hortob., Polyedropsis spinulosa (Schmidle) Schmidle and Pascherina tetras (Kors.) Silva were also recorded.

List of algal taxa of the Maros River (1980-)

CYANOPHYTA
Anabaena spiroides Kleb.
Anabaenopsis elenkinii Mull.
Aphanizomenon issatschenkoi (Uss.)Prosch.
Microcystis aeruginosa Kutz.
Oscillatoria granulata Gard.
O. limnetica Lemm.
O. prolifica (Grev.)Gom.
Oscillatoria spp.
Phormidium molle (Kutz.)Gom.
Spirulina laxissima G.S.West

EUGLENOPHYTA
Euglena acus Ehr.
E. allorgei Defl.
E. geniculata Duj.
E. limnophila Lemm.
E. polymorpha Dang.
E. proxima Dang.
E. viridis Ehr.
Petalomonas involuta Skuja
Phacus arnoldii Swir.
P. pusillus Lemm.
P. pyrum (Ehr.)Stein 3.
P. skujae Skv.
Strombomonas fluviatilis (Lemm.)Defl.
Trachelomonas hispida (Perty)Stein
T. volvocina Ehr.

PYRROPHYTA
Cryptomonas curvata Ehr. em. Pen.
C. erosa Ehr.
C. marssonii Skuja
C. obovata Skuja
C. ovata Ehr.
C. reflexa Skuja
Gymnodinium excavatum Nygaard 3.
Rhodomonas lacustris Pasch. et Rutt.

CHRYSOPHYTA
CHRYSOPHYCEAE
Chrysococcus biporus Skuja
C. rufescens Klebs
Dinobryon divergens Imhof
Mallomonas sp.
Synura globosa (Schiller)Starmach
S. uvella Ehr.

XANTHOPHYCEAE
Goniochloris mutica (A.Braun)Fott 3.

BACILLARIOPHYCEAE
Acanthoceras zachariaschii (Brun.)Simon.
Achnanthes clevei Grun. 2.
A. hungarica (Grun.)Grun. 2.
A. lanceolata (Bréb.)Grun. 2
A. lanceolata v. minor (Straub)Lange-Bertalot. 2.
A. minutissima v. minutissima Kutz.
A. plonensis Hust. 2.
Achnanthes sp.
Amphora normanii Rabh. 2.
Amphora spitzbergiensis Van Land. 2.
A. pediculus (Kutz.)Grun.
Asterionella formosa Hass.
Aulacoseira distans (Ehr.)Simon.
A. italica (Ehr.)Simon. 3.
A. granulata (Ehr.)Simon.
A. gr. v. angustissima (O.F.M.)Simon.
Caloneis amphisbaena (Bory)Cl. 2.

Cocconeis neodiminuta Krammer 2.
C. disculus (Schumann)Cl. 2.
C. placentula Ehr.
Cyclotella radiosa (Grun.)Lemm. 2.
C. glomerata Bach. 2.
C. meneghiniana Kutz.
C. pseudostelligera Hust. 2.
Cylindrothacca gracilis (Breb.)Gun. 2.
Cymatopleura solea (Breb.)W.Sm.
Cymbella helvetica Kutz. 2.
C. microcephala Grun. 2.
C. silesiaca Bleisch
C. sinuata Greg. 2.
C. silesiaca Bleisch in Rabenh. 2.
Diatoma tenuis Ag.
D. vulgaris Bory
Fragilaria arcus (Ehr.)Cl. v. arcus
F. capucina v. rumpens(Kutz.)Lange-Bertalot 2.
F. ulna (Nitzsch)Lange-Bertalot
Fragilaria ulna v. acus (Kutz.)Lange-Bertalot
Gomphonema angustatum (Kutz.)Raben.
G. augur Ehr.
G. parvulum (Kutz.)Kutz. 2.
G. pseudoaugur Lange-B.
G. olivaceum (Horn.)Breb.
Gyrosigma acuminatum (Kutz.)Rabh. 2.
G. scalproides (Rabenh.)Cl.
M. varians Ag.
Meridion circulare Ag.
N. cari Ehr. 2.
N. cincta (Ehr.)Ralfs
N. cryptocephala Kutz.
N. gregaria Donk. 2.
N. lanceolata (Ag.)Ehr.
N. menisculus Schuman
N. rhynchocephala Kutz.
N. tripunctata (O.F.M.)Bory 2.
N. veneta Kutz.
N. viridula (Kutz.)Ehr.
Nitzschia acicularis (Kutz.)W.Sm.
N. amphibia Grun. 2.
N. constricta (Kutz.)Ralfs in Pritch.
N. dissipata (Kutz.)Grun.
N. fonticola Grun.
N. fruticosa Hus.
N. gracilis Hantzsch 2.
N. hungarica Grun.
N. intermedia Hantzsch
N. palea (Kutz.)W.Sm.
N. paleacea Grun.
N. perminuta (Grun.)Peral.
N. recta Hantzsch 2.
N. reversa W.Sm.
N. subacicularis Hus.
N. sublinearis Hust. 3.
Nitzschia spp.
Rhizosolenia eriensis H.L.Smith
Skeletonema potamos (Weber)Hasle
Stephanodiscus hantzschii Grun. 2.
Stephanodiscus spp.
Surirella angusta Kutz. 2.
S. ovalis Breb.

CLOROPHYTA
Actinastrum hantzschii Lagerh.
Carteria wisconsinensis H.P.
Chlamydomonas spp.
Chlorogonium elegans (Dang.)Dang.
Closterium acutum v. variabile (Lemm.)Krieg. 3.
Coccomonas orbicularis Stein
Coelastrum microporum Naeg.
C. sphaericum Naeg.
Cosmarium botrytis Menegh.
Crucigenia apiculata (Lemm.)Schmidle
C. fenestrata Schmidle
C. quadrata Morr. 3.
C. tetrapedia (Kirschn.)W. et G.S.West
Dictyosphaerium anomalum Kors.
D. ehrenbergianum Naeg. sensu Skuja
D. pulchellum Wood 3.
Didymocystis planctonica Kors.
Didymogenes palatina Schmidle 3.
Eudorina elegans Ehr.
Franceia ovalis (France)Lemm.
Golenkinia viridis (Frenzel)Printz 3.
Gonium pectorale O.F.Muller
Granulocytopsis pseudocoronata (Kors.)Hind. 3.
Hyaloraphidium contortum Pasch.et Kors.
H. cont. v. tenuissimum Kors.
Kirchneriella irregularis ((G.M.)Smith)Kors. 3.
Komarekia appendiculata (Chod.)Fott
Korschikoviella limnetica (Lemm.)Silva 3.
Lagerheimia balatonica (Scherff.)Hind.
L. genevensis (Chod.)Chod.
L. longiseta (Lemm.)Wille
L. quadriseta (Lemm.)G.M.Smith
L. wratislaviensis Schroed.
Lobomonas ampla v.mammilata (Svir.)Kor.
Micractinium crassisetum Hortob.
M. pusillum Fres.
Monoraphidium arcuatum (Kors.)Hind.
M. contortum (Thur.)Kom.-Leg.
M. griffithii (Berk.)Kom.-Leg.
M. komarkovae Nyg.
Neodesmus danubialis Hind.
Nephrochlamys willeana (Printz)Kors.
Oocystis borgei Snow 3.
O. lacustris Chod. 3.
O. marssonii Lemm.
Pandorina morum (O.F.Muller)Bory
Pascherina tetras (Kors.)Silva
Pediastrum boryanum (Turp.)Menegh.

P. duplex Meyen
P. simplex Meyen 3.
P. tetras (Ehr.)Ralfs
Polyedropsis spinulosa (Schm.)Schmidle
Scenedesmus acuminatus (Lagerh.)Chod.
S. acutus Meyen
S. apiculatus (W. et G.S.West)Chod.
S. armatus Chod.
S. bicaudatus Dedus.
S. brevispina (G.M.Smith)Chod.
S. brevispina v. bicaudatus Hortob.
S. denticulatus Lagerh.
S. denticulatus v.linearis Hangs.
S. dispar (Breb.)Rabenh.
S. ecornis (Ehr.)Chod.
S. ecornis v.disciformis Chod.
S. ellipsoideus Chod.
S. intermedius Chod.
S. intermedius v.bicaudatus Hortob.
S. longispina Chod.
S. magnus Meyen
S. opoliensis P.Richt
S. ovalternus Chod.
S. protuberans Fritsch
S. quadricauda (Turp.)Breb.
S. spinosus Chod.
Schroederia indica Phil. 3.
S. setigera (Schroed.)Lemm.
S. spiralis (Printz)Kors.
Scourfieldia cordiformis Takeda
Staurastrum paradoxum Meyen
Tetraedron arthrodesmiforme (West)Wol.
T. caudatum (Corda)Hangs.
T. minimum (A.Br.)Hangs
T. proteiforme (Turn)Brun. 3.
T. triangulare Kors. 3.
Tetraselmis cordiformis (Carter)Stein
Tetrastrum glabrum (Roll)Ahl. et Tiff.
T. punctatum (Schmidle)Ahl. et Tiff.
T. staurogeniaeforme (Schroed.)Lemm.

µ alga (2-3 µ); markless: this study; 2. Dobler-Kovács (1981) only; 3. Hamar (1991) only

Quantitative changes

In the upper section of the river low numbers of individuals were found (0.06 - 0.14 x 10^6 ind/l) and diatoms dominated (72-92 %). Eutrophic indicator species: Nitzschia palacea Grun., Nitzschia acicularis (Kutz.) W.Sm. and Nitzschia palea (Kutz.) W.Sm. dominated. (Table 1, Fig. 2)

Diatoms remain the dominant group in the middle section; they contribute to total numbers by more than 50% . Dominants: Cyclotella meneghiniana Kutz. and the three diatoms listed before. Contribution of green algae is around 30% . Total numbers is higher (0.08 - 0.75 x $1o^6$ ind/l) than in upper sections. Diatoms and green algae almost equally contribute to total numbers in the lower river sections. Cyclotella meneghiniana, Stephanodiscus spp., Nitzschia acicularis and green µ-algae are important. Total numbers changed between 21.5 - 55 x 10^6 ind/l, which indicates that the water is eu-polytrophic and moderately polluted.

Ecological considerations

Composition of algal communities reflect both the hydrographical properties of the rivers and the effects of allochtonous factors, like pollution (Figs. 2-3). The quickly running (50 - 110 cm/s) Maros receives many small streams in its upper section. Correspondingly, algal abundance is low, diatoms dominate. However, species that indicate pollution appear in this section.

Flow velocity is lower in the middle section (20 - 30 cm/s). Beside rheophyl diatoms, planktonic diatoms and green algae are increasingly dominant. Composition of the algal assemblage indicates considerable pollution. There is a further decrease in velocity (5 - 25 cm/s) in the lower section, in addition the pollution is significant. A large number of planktonic species that characterize eu-polytrophic conditions and moderate pollution can be experienced (Figs. 1-3).

Fig.2. Dinamisms of the taxa and number of algae

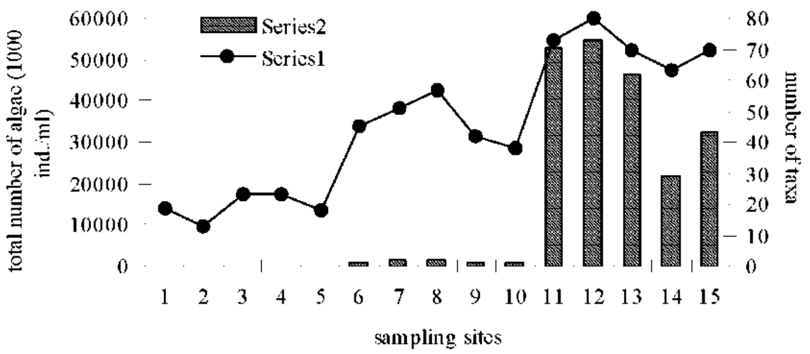
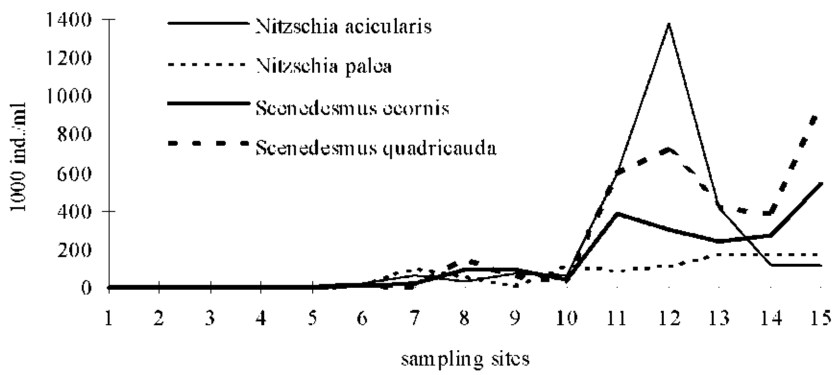


Fig.3. Indications of pollution by increase of individual number of some algal taxa



The above described phenomena are also reflected in correlation analyses. Algal numbers and number of species positively correlated (r= 0.85), while both are negatively correlated with Shannon-diversity (r= -0.64 and r= -0.86, respectively). The considerable

Table1. Quantitative dinamism of phytoplankton of the Maros river

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CYANOPHYTA															
Anabaena spiroides Kleb.								3			6				6
Anabaenopsis elenkinii Mull.										6			30		
Aphanizomenon issatschenkoi (Uss.)Pros.							3	6							
Microcystis aeruginosa Kutz.												6			
Oscillatoria granulata Gard.												6			
O. limnetica Lemm.							6	210	75	30	60	6		6	6
O. prolifica (Grev.)Gom.															6
Oscillatoria spp.	1.5		3	3	6			9	3	3					
Phormidium molle (Kutz.)Gom.					1.5						390	1200	960	120	600
Spirulina laxissima G.S.West								60	9	3	30	30			
total Cyanophyta	1.5		3	3	7.5		9	288	87	42	486	1248	990	126	618
EUGLENOPHYTA															
Euglena acus Ehr.						3		3							
E. allorgei Defl.											6				
E. geniculata Duj.						3	3								
E. limnophila Lemm.											6	6	30		6
E. polymorpha Dang.								6		6	30	6	6		6
E. proxima Dang.				1.5			3	3	3	3		30	30	30	6
E. viridis Ehr.											30	30			
Petalomonas involuta Skuja						3									
Phacus arnoldii Swir.	1.5														
P. skujae Skv.							3								
P. pusillus Lemm.							3								
Strombomonas fluviatilis (Lemm.)Defl.														6	
Trachelomonas hispida (Perty)Stein														6	
T. volvocina						3		3	3		30		6		6
total Euglenophyta	1.5			1.5		12	12	15	6	9	102	72	72	42	24

Table 1. (continued)

PYRROPHYTA														
Cryptomonas curvata Ehr. em. Pen.						3	3	3	3	30	24	60	60	60
C. erosa Ehr.										6	6	6	18	6
C. marssonii Skuja		1.5	1.5											
C. obovata Skuja		1.5	3	3		6					90	60	60	180
C. ovata Ehr.		1.5									6	6	120	60
C. reflexa Skuja					3		3							6
Rhodomonas lacustris Pasch. et Rutt.					9	150	3			60	30	6	30	6
total Pyrrophyta		4.5	4.5	3	12	159	9	3	3	96	156	138	288	318
CHRYSOPHYCEAE														
Chrysococcus biporus Skuja					3	3	3							
C. rufescens Klebs		4.5			15	24				30	30			
Dinobryon divergens Imhof		1.5			3									
Mallomonas sp.		9		1.5										
Synura globosa (Schiller)Starmach		4.5												
S. uvella Ehr.					3	3								
total Chrysophyceae		19.5		1.5	24	30	3			30	30			
BACILLARIOPYCEAE														
Acanthoceras zachariaschii (Brun.)Simon.							3					6	6	18
Achnanthes minutissima v.minutissima Kutz.			4.5	1.5	435	300	90	45		150	90	300	6	6
Achnanthes sp.								6						
Amphora pediculus Grun.							6							
Asterionella formosa Hass.														6
Aulacoseira distans (Ehr.)Simon.								135	30		12	120	6	6
A. granulata (Ehr.)Simon.					3	3	9		3	6	12	60	90	60
A. gr. v.angustissima (O.Mull.)Simon.								6		30	6	120	30	90
Cocconeis placentula Ehr.	1.5		4.5	3		6		3						
Cyclotella cf. meneghiniana Kutz.	1.5	3	1.5		150	195	540	105	120	22500	18675	9600	7800	16000
Cymatopleura solea (Breb.)W.Sm.			1.5											
Cymbella silesiaca Bleisch		1.5												
Diatoma tenuis Ag.												12	6	
D. vulgaris Bory								3						
Fragilaria ulna (Nitzsch)Lange-Bertalot	1.5		6			6		3				6		

Table 1. (continued)

F. ulna v.acus (Kutz.)Lange-Bertalot	3											30	60	6	
Gomphonema angustatum (Kutz.)Raben.	1.5			4.5	7.5		3								
G. augur Ehr.	1.5	1.5	1.5												
G. pseudoaugur Lange-Bertalot															
G. olivaceum (Horn.)Breb.															6
Melosira varians Ag.			1.5		1.5										
Meridion circulare (Grev.)Ag.				1.5											
Navicula cincta (Ehr.)Ralfs								3				6			
N. cryptocephala Kutz.	1.5	1.5	3			3							6		
N. lanceolata (Ag.)Ehr.	1.5														
N. menisculus Schuman							6								
N. rhynchocephala Kutz.	3		3	1.5	1.5	3	3	3	9			60	6		
N. veneta Kutz.		1.5													
N. viridula (Kutz.)Ehr.	3			1.5		3	6		6						
Nitzschia acicularis (Kutz.)W.Sm.	4.5		7.5	6	9	18	60	30	75	60	600	1380	420	120	120
N. dissipata (Kutz.)Grun.		1.5													
N. fonticola Grun.	4.5	9	7.5	1.5						3					
N. fruticosa Hus.											6	30	60	6	180
N. hungarica Grun.						3				3				18	
N. intermedia Hantzsch		24								3					
N. palea (Kutz.)W.Sm.		4.5	10.5	4.5	4.5	24	105	60	6	120	90	120	180	180	180
N. paleacea Grun.	9	10.5	36	28.5	27	3	27	6	15	105	6	30			
N. perminuta (Grun.)Peral.	6	4.5	7.5	1.5											
N. reversa W.Sm.						6	6	6		30	30	6	6	60	18
N. subacicularis Hus.						3		3	12	30	30	60		60	180
Nitzschia spp.	7.5	4.5	6	3	1.5	15	24	3	6	45	60	6	12	60	120
Rhizosolenia eriensis H.L. Smith											6	6	6	6	
Skeletonema potamos (Weber)Hasle											18	30	6	6	120
Stephanodiscus spp.											1800	5400	7200	1200	1200
Surirella ovalis Breb.		1.5	1.5	1.5	1.5										
oher diatoms	3	1.5	12	1.5	18		3	3	9	6	6	12	6	60	
total Bacillariophyceae	54	66	102	75	76.5	669	750	762	444	558	25338	25971	18192	9726	16322

Table 1. (continued)

CHLOROPHYTA															
Actinastrum hantzschii Lagerh.											6	60	60		
Carteria wisconsinensis H.P.						3	3								
Chlamydomonas spp.	1.5	10.5	4.5	1.5		135	60	60	9	9	120	160	240	120	180
Chlorogonium elegans (Dang.)Dang.											6	30			
Coccomonas orbicularis Stein							3		6						
Coelastrum microporum Naeg.								3			12	120	120	12	30
C. sphaericum Naeg.											6	12	60		6
Cosmarium botrytis Menegh.													120		
Crucigenia apiculata (Lemm.)Schmidle						3	3	6			6	90			
C. fenestrata Schmidle															6
C. tetrapedia (Kirschn.) W. et G.S.West						3	3	6		3			60	6	6
Dictyosphaerium anomalum Kors.											30				
D. ehrenbergianum Naeg. sensu Skuja											150	150	60	60	
Didymocystis planctonica Kors.						6		3	3	6	60	90		12	60
Eudorina elegans Ehr.							3						6		
Franceia ovalis (France)Lemm.												30			
Gonium pectorale O.F.M.						3									
Hyaloraphidium contortum Pasch. et Kors.									9	3					
H. c. v.tenuissimum Kors.						3	3								
Komarekia appendiculata (Chod.)Fott															30
Lagerheimia balatonica (Scherff.)Hind.											6	6		90	60
L. genevensis (Chod.)Chod.											12	30	60		
L. longiseta (Lemm.)Wille												30			
L. quadriseta (Lemm.)G.M.Smith										3					
L. wratislaviensis Schroed.											6	60			30
Lobomonas ampla v.mammilata (Svir.)Kor.											6	6			
Micractinium crassisetum Hortob.											30				
M. pusillum Fres.											60	60	6	6	30

Table 1. (continued)

Monoraphidium arcuatum (Kors.)Hind.				3	3		30				
M. contortum (Thur.)Kom.-Leg.		24	105	90	3	45	810	540	1140	420	780
M. griffithii (Berk.)Kom.-Leg.		3	3	3	3	6	30	90	160	60	6
M. komarkovae Nyg.		45	24	3	9		30	30	240	60	60
Neodesmus danubialis Hind.		3	3				6				
Nephrochlamys willeana (Printz)Kors.		3		3	3		6		60		30
Oocystis marssonii Lemm.								6		6	60
Pandorina morum (O.F.M.)Bory											6
Pascherina tetras (Kors.)Silva							6	12			
Pediastrum boryanum (Turp.)Menegh.				3	3			30	60	6	
P. duplex Meyen					3			60	60		
P. tetras (Ehr.)Ralfs									6		60
Polyedropsis spinulosa (Schmidle)Schmidle							12			6	30
Scenedesmus acuminatus (Lagerh.)Chod.			3	3	3		90	180	60	6	90
S. acutus Meyen				3			12			6	
S. apiculatus (W. et G.S.West)Chod.									6		
S. armatus Chod.			3								
S. bicaudatus Dedus.			3	6	3	9	30		60	6	30
S. brevispina (G.M.Smith)Chod.				3		3					
S. b. v.bicaudatus Hortob.							6	30		6	30
S. denticulatus Lagerh.				3			6	30	6	30	
S. d. v.linearis Hangs.				3				6	60	6	60
S. dispar (Breb.)Rabenh.						3					
S. ecornis (Ehr.)Chod.		9	24	90	90	45	390	300	240	270	540
S. e. v.disciformis Chod.	1.5										
S. ellipsoideus Chod.										6	
S. intermedius Chod.			3	3	3		6	120	180	60	120
S. i. v.bicaudatus Hortob.				3			6	6			
S. longispina Chod.					3	3	6	6	6		6
S. magnus Meyen						3	30	6	6	60	30
S. opoliensis P.Richt							60	6	6		120
S. ovalternus Chod.			3					60	60	90	6

Table 1. (continued)

S. protuberans Fritsch								3		9		60	60	12	120
S. quadricauda (Turp.)Breb.						6	3	150	60	30	600	720	420	390	960
S. spinosus Chod.						9	9	12	3	6	240	180	240	210	240
Scourfieldia cordiformis Takeda															60
Schroederia setigera (Schroed.)Lemm.								3			12	30	60	6	60
S. spiralis (Printz)Kors.						3		3			6	12	30		6
Staurastrum paradoxum Meyen						3	3					6			
Tetraedron arthrodesmiforme (West)Wol.											30	60			6
T. caudatum (Corda)Hangs.												30		6	
Tetraedron minimum (A.Br.)Hangs.						6	3	6			30	120		12	6
Tetraselmis cordiformis (Carter)Stein						3	3	3					6		
Tetrastrum glabrum (Roll)Ahl. et Tiff.						3			3	3	30	90	6	60	60
T. punctatum (Schmidle)Ahl et Tiff.						3		3			60	120	6		
T. staurogenieforme (Schroed.)Lemm.							3				30		6	6	120
other Chlorococcales				1.5	10.5	60	75	90	180	180	240	120			
u alga (2-3 u)											23250	23400	22630	9000	9000
total Chlorophyta	1.5	10.5	4.5	4.5	10.5	339	351	573	402	369	26616	27400	26742	11112	13140
TOTAL NUMBER OF ALGAE	58.5	76.5	134	88.5	99	1044	1284	1653	942	981	52668	54877	46534	21534	32410
Number of taxa	19	13	23	23	18	45	51	57	42	38	73	80	70	63	70
H' - diversity (Shannon-Weaver)	3.9	3	3.8	3.8	3.3	3.3	3.9	3.7	4	4.1	2	2.4	2.5	2.5	2.8
S saprobity index (Pantle-Buck)	2.14	2.07	2.05	2	1.83	2.25	2.35	2.2	1.95	2.16	2	2.34	2.27	2.1	2.2

decrease in diversity in the lower section clearly indicates the immense changes in community structure which is caused by pollution. From Alba Iulia - from this point, which marks the beginning of the lower section of the river, phytoplankton structures strike one more as a well-operated sewage oxidation pond than a river.

Conclusions

Composition of algal communities of the Maros River well reflects both the hydrogeological background and human impacts. Surroundings of the heleocren type source has been already slightly polluted. In its upper region the river flows through a basin with only a slight slope (Giurgeu Basin), where the level of pollution increases. In the Toplipa-Deda strait self-purification occurs.

The middle section begins above the river dam at Tîrgu Mureş. Downstream impacts of sewage water from Tîrgu Mureş and Luduş can be observed. The two considerable streams, Arieş and Tîrnava, dilute the river.

The lower section begins at Alba Julia, where the river receives a high level of pollution. The leads to an algal community structure that characterizes sewage oxidation ponds. The water quality slightly improves in the lower section, where sewage from Makó contributes to an increase in the level of pollution.

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References

Ádámosi,M., Végvári P.,Hamar J.,B.Tóth M., Ferencz M. and Szitó A.(1978): Limnological investigations in the longitudinal section of the Tisza River.- Tiscia 13,99-140.

Dobler. E.-Kovács,K. (1981): On the diatoms, chlorophyll-a and pheophytin-a in the sediment of the Tisza and its tributaries.- Tiscia 16, 93-111.

Hamar,J. (1991): Algological investigation of the Tisza River and its tributaries in 1990.- Manuscript, 1-50.(Hungarian)

Lepsi.I. (1925-26): Über das Oktober-Plankton des Mures(Marosch).- Ver. u. Mitt. d. Siebenbürg Vereins für Naturwiss. zu Hermannstadt. vol.I. nr.75-76.,31-38.

Peterfi.St. şi Róbert,A. (1958): Note asupra unor forme noi şi rare de diatomee (Notes on new and rare diatom forms).- Studii şi Cercet. de Biol. (Cluj), vol.IX. nr.2., 243-248.

Róbert,A. (1960): Contribuþii la studiul diatomeelor dintr-un brat morþ al Mureşului la Tîrgu-Mureş (Contributions to the study of diatoms in a Mureş oxbow lake near Tg. Mureş)- Studia Universitatis Babeş-Bolyai, ser.II., Fasc. 2., 79-87.

Róbert,A. (1962): Noi contribuþii la studiul diatomeelor din-un braþ morþ al Mureşului la Tîrgu-Mureş (Further contributions to the study of diatoms in a Mureş oxbow lake near Tg. Mureş).- Contribuþii Botanice. Cluj. 39-44.

Róbert,A. (1968): Contributii la studiul diatomeelor din rîul Mureş la Tîrgu-Mureş (Contributions to the study of diatoms in the Mureş River at Tg. Mureş).- Contribuþii Botanice. Cluj. 31-36.

Schaarschmidt,Gy. (1880): Additamenta ad Algologiam Dacicam II. Enumeratio Algarum nonnularum in Comitatibus Naszód-Beszterce, Doboka Kolos, Torda-Aranyos, Alsó-Fehér, Udvarhely, Fogaras, Szeben et Hunyad lectarum.- Magyar Növénytani Lapok. IV.

Uherkovich,G. (1971): A Tisza lebegő paránynövényei-A Tisza fitoszesztonja (The phytoplankton of the Tisza River).- Szolnok, 1-282.

Váncsa,A.L. (1981): Qualitative and quantitative studies on the non-diatom algae of sediment samples collected in the longitudinal section of the Tisza.- Tiscia 16,113-130.

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