# Physical-chemical characteristics and phytoplankton composition of the Sava River on its lower flow stretch through Serbia

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## Introduction

Sava River is the right side tributary and with regard to the amount of water the richest tributary of the Danube River, which joins it at Beograd. Its length is 945.5 km, and its basin covers the area of 95719 km$^2$. There are 15687 km$^2$ (16.4%) of basin area on the territory of Serbia. Sava is formed of two alpine rivers, Sava Dolinka (50.5 km) and Sava Bohinjka (39.3 km) that unite close to Radovljice in Slovenia. Sava basin mostly covers mountain areas of the Alps and the Dinarian mountains, while its plane part covers 21.9 % of its total area (Gavrilović, 2002). Sava flows through Serbia by its lower stretch that has all the characteristics of a plane river. The width of the lower stretch of Sava varies. The maximum width is at Šabac 650-700 m, and on average 410 m between Šabac and Beograd and 280 m at the join of Danube. Under middle water levels the maximum depth of 28 m is found at Bosut and Popovača. The Sava is 18 m deep at Sremska Mitrovica and 17 m deep at the join with Danube. Sava is very rich in water. At lower stretch maximum discharges are measured during spring, i.e. downstream of the river Drina which is the largest tributary of the river Sava. The minimum discharges are measured in the lower stretch of the Sava River during early autumn. Later the discharge increases due to the autumn rains (Gavrilović, 2002). Republic Hydrometeorologic Service of Serbia carries out water quality examinations on localities of Jamena (boundary locality), Sremska Mitrovica, Šabac and Ostružnica. This paper presents the results of monthly measurements of physical-chemical characteristics and seasonal examinations of phytoplankton (April, June, August, October) during 2003-2004.

## Materials and methods

Water samples for physical-chemical analysis were taken using standard procedures (Standard methods, 1989). Plankton samples were taken by a plankton net (mesh size 25 µm, Sournia, 1978). The samples were preserved with formaldehyde (4% final concentration) immediately. Analyses of physical-chemical parameters were performed according to standard analytical procedures: JUS-ISO, EPA. Classification of chemical parameters was made due to ICPDR classification standard. Phytoplankton analysis was carried out using an inverted microscopes with phase contrast (Zeiss, Axiovert type and Nikon, Eclipse TE2000-U). The Nikon microscope was equipped with a digital camera and a software programme (Eclipsenet) for photographing and processing of the photographs. For morphological determination of diatoms frustules were acidified and oxidised by the method of Husted (1966), modified by Cramer, Lange-Bertalot (1986) and then embedded in Canada balsam. In most cases the species, the morphological variety or the form was determined, in a few cases the genus could be identified only. Relative abundance of all taxa present was given in accordance with six-level scale after Pantle-Buck (SEV, 1983). The organisms used for the indication of the sabrobiological conditions were used following the list of indicatory organisms (SEV, 1977).

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## Results and discussion

Table 1. Statistical characteristics of water quality in the Sava River from 2003-2004.

| Parameter | | Jamena | | | | | | Sremska Mitrovica | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | n | min | mean | max | C90 | Class | n | min | mean | max | C90 | Class |
| Dissolved Oxygen (mg/l) (<0.2)* | 2003 | 21 | 4.8 | 9.7 | 12.6 | 6.8* | II | 22 | 6.3 | 10.0 | 12.5 | 7.5* | I |
| | 2004 | 24 | 6.0 | 9.3 | 12.4 | 6.6* | II | 23 | 7.4 | 9.9 | 12.2 | 8.0* | I |
| BOD (5) (mg/l) (<0.5)* | 2003 | 17 | 0.6 | 2.1 | 5.0 | 3.9 | II | 16 | 0.5 | 2.0 | 4.4 | 3.7 | II |
| | 2004 | 22 | 0.5 | 1.4 | 2.8 | 2.2 | II | 21 | 0.7 | 1.2 | 2.4 | 1.7 | I |
| COD(Mn) (mg/l) (<0.5)* | 2003 | 22 | 2.0 | 2.9 | 5.6 | 3.6 | I | 22 | 1.7 | 2.4 | 3.2 | 3.0 | I |
| | 2004 | 24 | 2.1 | 3.1 | 5.7 | 4.2 | I | 23 | 1.9 | 2.5 | 4.3 | 3.1 | I |
| Ammonium ($NH_4$-N) (mg/l) (<0.01)* | 2003 | 21 | 0.01 | 0.10 | 0.17 | 0.15 | I | 20 | 0.01 | 0.09 | 0.24 | 0.11 | I |
| | 2004 | 24 | 0.01 | 0.03 | 0.13 | 0.07 | I | 23 | 0.01 | 0.02 | 0.16 | 0.06 | I |
| Nitrite ($NO_2$-N) (mg/l) (<0.003)* | 2003 | 21 | 0.003 | 0.006 | 0.032 | 0.014 | II | 20 | 0.003 | 0.004 | 0.010 | 0.005 | I |
| | 2004 | 24 | 0.003 | 0.003 | 0.006 | 0.004 | I | 23 | 0.003 | 0.005 | 0.040 | 0.004 | I |
| Nitrate($NO_3$-N) (mg/l) (<0.03)* | 2003 | 21 | 0.10 | 0.96 | 1.71 | 1.62 | II | 20 | 0.42 | 0.97 | 1.60 | 1.43 | II |
| | 2004 | 24 | 0.61 | 1.06 | 2.18 | 1.84 | II | 23 | 0.26 | 0.95 | 1.77 | 1.67 | II |
| Total Nitrogen (mg/l) (<0.1)* | 2003 | 15 | 1.1 | 2.7 | 4.5 | 4.1 | III | 13 | 1.0 | 2.0 | 4.0 | 3.1 | II |
| | 2004 | 24 | 0.8 | 1.8 | 3.0 | 2.8 | II | 23 | 0.8 | 1.8 | 2.8 | 2.7 | II |
| Orthophosphate ($PO_4$-P) (mg/l) (<0.005)* | 2003 | 21 | 0.018 | 0.057 | 0.121 | 0.082 | II | 20 | 0.026 | 0.047 | 0.096 | 0.064 | II |
| | 2004 | 23 | 0.010 | 0.030 | 0.050 | 0.046 | I | 23 | 0.006 | 0.028 | 0.050 | 0.041 | I |
| Total phosphorus (mg/l) (<0.005)* | 2003 | 12 | 0.063 | 0.095 | 0.146 | 0.142 | II | 12 | 0.052 | 0.083 | 0.118 | 0.111 | II |
| | 2004 | 12 | 0.014 | 0.074 | 0.343 | 0.110 | II | 12 | 0.018 | 0.052 | 0.094 | 0.080 | I |
| **Parameter** | | **Šabac** | | | | | | **Ostružnica** | | | | | |
| | Year | n | min | mean | max | C90 | Class | n | min | Sr.vr. | max | C90 | Class |
| Dissolved Oxygen (mg/l) (<0.2)* | 2003 | 23 | 5.7 | 9.6 | 12.9 | 6.4* | II | 24 | 5.4 | 10.1 | 13.6 | 6.9* | II |
| | 2004 | 24 | 6.8 | 9.7 | 13.2 | 7.5* | I | 24 | 6.6 | 10.5 | 13.5 | 7.9* | I |
| BOD-5 (mg/l) (<0.5)* | 2003 | 15 | 0.6 | 2.3 | 5.9 | 2.9 | I | 22 | 1.2 | 2.3 | 3.5 | 3.2 | II |
| | 2004 | 22 | 0.6 | 1.4 | 2.5 | 2.3 | I | 23 | 1.1 | 2.4 | 4.7 | 3.3 | II |
| COD (Mn) (mg/l) (<0.5)* | 2003 | 23 | 1.8 | 2.5 | 3.5 | 3.4 | I | 24 | 2.6 | 3.5 | 4.6 | 4.3 | I |
| | 2004 | 24 | 1.6 | 2.5 | 3.6 | 3.3 | I | 24 | 2.2 | 3.4 | 7.5 | 4.4 | I |
| Ammonium ($NH_4$-N) (mg/l) (<0.01)* | 2003 | 22 | 0.04 | 0.09 | 0.15 | 0.12 | I | 24 | 0.02 | 0.13 | 0.33 | 0.20 | I |
| | 2004 | 24 | 0.01 | 0.02 | 0.10 | 0.03 | I | 24 | 0.01 | 0.07 | 0.25 | 0.15 | I |
| Nitrite ($NO_2$-N) (mg/l)m (<0.003)* | 2003 | 22 | 0.003 | 0.004 | 0.011 | 0.004 | I | 24 | 0.003 | 0.024 | 0.103 | 0.047 | II |
| | 2004 | 24 | 0.003 | 0.003 | 0.006 | 0.003 | I | 24 | 0.003 | 0.035 | 0.091 | 0.067 | III |
| Nitrate ($NO_3$-N) (mg/l) (<0.03)* | 2003 | 22 | 0.36 | 0.91 | 1.55 | 1.33 | II | 24 | 0.24 | 0.87 | 1.39 | 1.33 | II |
| | 2004 | 24 | 0.57 | 0.96 | 1.81 | 1.58 | II | 24 | 0.56 | 1.13 | 1.80 | 1.62 | II |
| Total Nitrogen (mg/l) (<0.1)* | 2003 | 13 | 1.3 | 2.4 | 3.6 | 3.0 | II | 11 | 0.7 | 1.9 | 3.7 | 2.7 | II |
| | 2004 | 24 | 0.6 | 1.7 | 2.9 | 2.4 | II | 22 | 0.7 | 2.6 | 5.6 | 4.1 | III |
| Orthophosphate ($PO_4$-P) (mg/l) (<0.005)* | 2003 | 22 | 0.024 | 0.048 | 0.122 | 0.059 | II | 24 | 0.027 | 0.077 | 0.193 | 0.114 | III |
| | 2004 | 23 | 0.006 | 0.030 | 0.056 | 0.050 | I | 24 | 0.010 | 0.057 | 0.127 | 0.098 | II |
| Total phosphorus (mg/l) (<0.005)* | 2003 | 12 | 0.058 | 0.086 | 0.131 | 0.119 | II | 12 | 0.054 | 0.092 | 0.202 | 0.129 | II |
| | 2004 | 11 | 0.017 | 0.048 | 0.081 | 0.072 | I | 23 | 0.032 | 0.092 | 0.242 | 0.131 | II |

- BOD-5 (Biological Oxygen Demand after five days), $COD_{Mn}$ (Chemical Oxygen Demand )
- C90- (C10 for Dissolved Oxygen ) The 90 percentile of the measurements done in the year
- * the detection limit, the value of detection limit was used in statistical processing of the data.
- For the purposes of classification, the "testing value" has been calculated for each determinand, which is further compared to limit values for water quality classes[TNMN Yearbook 2001] and a corresponding class assigned to determinand. The testing value is equal to 90 percentile (10 percentile for dissolved oxygen and lower limit of pH value), if the number of measurements in a year was at least eleven.

The water temperature ranged from a minimum of 2.0 $^{o}$C in January 2003 at Jamena to a maximum of 28.8°C in August 2003 at Ostružnica. Water was slightly alkaline. $BOD_5$ and COD values indicated slight organic pollution of water which corresponds to earlier measurements (Laušević, 1998). In general high concentrations of dissolved oxygen were recorded. Supersaturation with oxygen was recorded occasionally during summer. Concentrations of ammonia and nitrates were low and were in the range of classes I, II. Concentrations of nitrit and total nitrogen were in the same range on localities of Sremska Mitrovica and Sabac, In contrast Jamena showed a higher concentration of total nitrogen (class III). At Ostruznica concentrations of these nutrients also were higher during 2004 and within the range of class III. Concentrations of orthophosphate and total phosphor were in the range of class II at Jamena, Sremska Mitrovica and Šabac during 2003 and even decreased

during 2004 (class I). Increasing concentrations of orthophosphate were recorded at Ostružnica during 2003 (class III) while during 2004 orthophospate only increased in late summer. Comparing the measurements of this study to the period from 1995-1996 (Lausević, 1998) phosphate concentrations slightly increased in the lower stretch of the Sava River, close to Beograd. Concentrations $SiO_2$ were between 2-12 mg $dm^{-3}$, which is considered sufficient for the development of diatoms.

Phytoplankton was of a heterogeneous composition, in total 185 taxa from 8 algal divisions were described. Bacillariophyta (67 taxa, 36.2%) and Chlorophyta (64 taxa, 34.6%) constituted most taxa. Cyanoprokaryota contained 22 taxa (11.9%) and Euglenophyta contained 18 taxa (9.7%). All other divisions were represented with a small number of taxa only: Chrysophyta (6 taxa, 3.2%), Pyrrhophyta (6 taxa, 3.2%), Xanthophyta (1 taxon, 0.5%) and Rhodophyta (1 taxon, 0.5%). In general the phytoplankton composition was similar to the composition in the Danube river (Čađo, 2006). Typically water circulation inoculates taxa originating from the phytobenthos and the phytoperiphyton, which has also been observed during earlier surveys of the lower stretch of the Sava River (Lauševic 1998; Martinović-Vitanović 1996). Comparing the results of this study with the study of Martinović-Vitanović (1996), a lower number of taxa was recorded. This differences are likely to be caused by a difference in the frequency of sampling and the investigation period, for example the study of Laušević *et al*.(1996) showed a high number of taxa during the investigation period from 1982-1989. Notably, 43 new taxa were recorded. The species *Didymosphaenia geminata* that was also recorded from the River Danube and the River Tisa was also detected in the River Sava at Jamena in October 2004. Some taxa, previously recorded have not been observed.

Floristic list of taxa in phytoplankton of Sava River 2003-2004 (*, new taxa when compared to earlier investigations (Laušević *et al*. 1996).

Cyanoprokaryota: *Anabaena* Bory sp., *Anabaena solitaria* Klebs, *Aphanizomenon flos-aquae* (L.) Ralfs, **Aphanizomenon issatschenkoi* (Ussaczev) Prošk-Lavr., **Aphanocapsa incerta* (Lemm.) Cronberg et Kom., **Geitlerinema amphibia* (Agardh ex Gom.) Anagn., *Leptolyngbya foveolarum* (Rabenh. ex Gom.) Anag. et Kom. **Limnothrix redekei* (van Goor) Meffert **Merismopedia elegans* A. Braun in Kützing, *Microcystis aeruginosa* Kützing, *Oscillatoria limosa* (Roth) Agardh, **Oscillatoria planctonica* Wolosz., *Oscillatoria princeps* Vaucher, *Oscillatoria sancta* Agardh ex Gomont, **Phormidium chalybeum* (Mertens ex Gomont) Anagn. Et Kom., **Phormidium formosum* ( Bory ex Gom.) An. et Kom. *Phormidium* Kütz. sp., *Phormidium tenue* (Agardh ex Gomont) Anagn. Et Kom., **Planktothrix rubescens* (de Candolle ex Gom.) An. et Kom., *Pseudoanabaena limnetica* (Lemm.) Kom., *Snowella lacustris* (Chodat) Kom. Et Hindak, **Spirulina major* Kütz. ex Gom.
Chrysophyta: *Chrysococus* Klebs sp., *Dinobryon divergens* Imhof, *Dinobryon sertularia* Ehrb., *Dinobryon* Ehrb. Sp., *Malomonas acaroides* Perty, *Synura uvella* Ehrb.
Bacillariophyta: *Achnanthes* Bory sp., *Amphora ovalis* Kütz. (Kütz.), *Anomoeoneis sphaerophora* (Ehrb.) Pfitzer, *Asterionella formosa* Hassall, *Aulacoseira granulata* (Ehrb.) Simonsen, *Aulacoseira granulata* (Ehrb.) Sim. *var. angustissima* (O.F.M.) Simonsen, *Caloneis amphisbaena* (Bory) Cl., *Caloneis silicula* (Ehrb.) Cl., *Cocconeis pediculus* Ehrb., *Cocconeis placentula* Ehrb., *Cyclotella meneghiniana* Kützing, *Cymatopleura elliptica* Bréb., *Cymatopleura solea* (Bréb.) W. Smith, *Cymatopleura solea var. apiculata* (W. Smith) Ralfs, *Cymbella affinis* Kützing, *Cymbella lanceolata* (Ehrb.) Heuck, *Cymbella minuta* Hilse, *Cymbella prostrata* Cleve, *Cymbella tumida* (Bréb.) Van Heurck, *Diatoma tenuis* Agardh, *Diatoma vulgaris* Bory, **Didymosphaenia geminata* (Lingb.), *Epithemia turgida* (Ehrb.) Kützing, *Fragilaria arcus* (Ehrb.) Kützing, **Fragilaria capucina* Desm., *Fragilaria construens* (Ehrb.) Grunow, *Fragilaria crotonensis* Kitton, **Fragilaria dilatata* (Bréb.) Lange-Bert., *Fragilaria ulna* (Nitzsch) Lange-Bert., *Fragilaria ulna* (Nitzsch) Lange-Bert. *var.acus* (Kütz.) Lange-Bert., *Gomphonema augur* Ehrb., *Gomphonema acuminatum* Ehrb., *Gomphonema olivaceum* (Hornem.) Bréb., *Gomphonema parvulum* (Kütz.) Grun., **Gomphonema truncatum* Ehrb., *Gyrosigma acuminatum* (Kütz.) Rab., *Gyrosigma nodiferum* (Grun) Reimer, *Hantzschia amphioxys* (Kutz.) Grunow, **Melosira lineata* (Dillwyn) Agardh, *Melosira varians* Agardh, *Meridion circulare* (Grev.) Agardh, *Navicula cryptocephala* Kützing, *Navicula cuspidata* Kützing, *Navicula radiosa* Kützing, *Navicula rhynchocephala* Kützing, *Navicula tripunctata* (O.F.M.) Bory, *Navicula viridula* Kützing, *Neidium dubium* (Ehrb.) Cleve, *Nitzschia acicularis* W. Smith, *Nitzschia fruticosa* Hustedt, *Nitzschia linearis* W. Smith, *Nitzschia palea* (Kütz.) Smith, *Nitzschia sigmoidea* (Ehrb.) Smith, *Nitzschia vermicularis* Grunow, *Nitzshia dissipata* (Kütz.) Grun., *Pinnularia viridis* (Nitzsch) Ehrb., *Rhoicosphaenia abbreviata* (C. Agardh) Lange-Bert., *Rhopalodia gibba* (Ehrb.) O.F.M., **Skeletonema potamos* (Weber) Hasle, *Stephanodiscus* Ehrb. sp., *Stephanodiscus hantzschii* Grun., *Surirella biseriata* Bréb., *Surirella capronii* Bréb., *Surirella minuta* Bréb., *Surirella splendida* (Ehrb.) Kützing, *Surirella tenera* Gregory, *Tabellaria fenestrata* (Lyngb.) Kützing.
Xanthophyta: *Centritractus belenophorus* Lemm.
Pyrrhophyta: *Ceratium hirundinella* (O.F.M.) Bergh, *Cryptomonas* sp., *Gymnodinium* (Stein) Kofoid & Swe sp., **Peridinium cinctum* (O.F.M.) Ehrb., *Peridinium* Ehrb. sp., **Peridinium inconspicum* Lemm.
Euglenophyta: *Euglena acus* (Duj.) Hubner, **Euglena ehrenbergii*, *Euglena limnophyla* Lemm., **Euglena oxyuris* Schmarda, *Euglena proxima*, *Euglena* sp., *Euglena viridis* Ehrb., *Lepocinclis ovum* Ehrb. Lemm., *Phacus caudatus*, **Phacus*

*chloroplastes* Prescott, *Phacus longicauda* (Ehrb.) Duj., *Phacus orbicularis* Hubner, **Phacus pleuronectes* (O.F.M.) Duj., *Trachelomonas armata*, **Trachelomonas caudata* (Ehrb.) Stein, *Trachelomonas hispida* (Perty) Stein em. Defl., *Trachelomonas* Ehrb. sp., *Trachelomonas volvocina* Ehrb.
Chlorophyta: **Acanthosphaera zachariasii* Lemm., **Actinastrum aciculare* Playf, *Actinastrum hantzschii* Lagerheim, *Ankistrodesmus bibraianus* (Reinsch) Korš., **Carteria globosa*, *Chlamydomonas* Ehrb. sp., *Chlorella vulgaris* Beijerinck, *Closterium acerosum* Ehrb., *Closterium aciculare* T.West, *Closterium acutum var. variabile* Lemm. Kreiger, *Closterium limneticum* Lemm., *Closterium moniliferum* (Bory) Ehrb., *Closterium* Nitzsch sp., **Closterium strigosum* Bréb., **Coelastrum astroideum* De Not, *Coelastrum microporum* Näg., **Coelastrum reticulatum* (Dang.) Senn, *Cosmarium* Corda sp., *Crucigenia tetrapedia* (Kirchn.)W & G.S.West, *Crucigeniella apiculata* (Lemm.) Kom., **Dictyosphaerium ehrenbergianum* Nag, **Dictyosphaerium tetrachotomum* Printz, *Eudorina elegans* Ehrb., **Gloeotila* Kützing sp., **Golenkinia radiata* Chodat, *Gonium pectorale* Muller, **Hyaloraphidium contortum* Pasch & Korš., **Micractinium bornchaemiense* (Conr.) Korš., *Micractinium pusillum* Fres., **Micractinium quadrisetum*(Lemm.) G. M. S., **Monoraphidium contortum* (Thur.) Com.-Leg., *Monoraphidium griffithii* (Berk) Com.-Leg., *Mougeotia* Ag. sp., *Oocystis lacustris* Chodat, **Oocystis marssonii* Lemm., *Pandorina morum* (Bory), *Pediastrum boryanum var. boryanum* (Turp.) Meneghini, *Pediastrum boryanum* (Turp.) Meneghini *var. longicorne* Reinsch, *Pediastrum duplex* Meyen *var. gracillimum* W&G. S. West, *Pediastrum duplex var. duplex* Meyen, *Pediastrum simplex* Meyen *var. echinulatum* Wittz, *Pediastrum simplex var. simplex* Meyen, *Pediastrum tetras* Ralfs, *Scenedesmus acuminatus* (Lag.) Chod., *Scenedesmus acutus* Meyen, *Scenedesmus bicaudatus* (Hansg.) Chod., **Scenedesmus brasiliensis* Bohl, *Scenedesmus disciformis* (Komarek) Chod., *Scenedesmus ecornis* (Ehrb.) Chod. Sensu Unerk., **Scenedesmus magnus* Meyen, *Scenedesmus opoliensis* Richt., *Scenedesmus quadricauda* (Turp.) Bréb., **Scenedesmus sempervirens* (Chod.), **Scenedesmus smithii* Teiling, *Schroederia setigera* (Schrod) Lemm., *Spirogyra* Link sp., *Staurastrum chaetoceros* (Schr.) G. M. Smith,, **Staurastrum gracile* Ralfs, *Stigeoclonium* Kützing sp., *Tetraedron regulare* Kütz. sensu Skuja, *Tetraedron trigonum* Näg (Hansg) sensu Skuja, *Tetrastrum heteracanthum* (Nordst.) Chod., **Tetrastrum staurogeniaeforme* (Schr.) Lemm, *Tetrastrum triangulare* (Chod.) Kom.
Rhodophyta: *Audouinella chalybea* (Lyngb.) Fries

Phytoplankton was classified semi-quantitatively using the scale of Pantle & Buck (SEV,1983). The following categories of abundances have been used: 1-individually, 2-rarely, 3-moderately abundant, 5-abundant, 7- very abundant and 9-mass. The lower stretch of the Sava River was dominated by centric diatoms: *Cyclotella meneghiniana*, *Stephanodiscus hantzschii* and *Aulacoseira granulata.* The dominance of *Cyclotella meneghiniana* was observed by Lausevic et al. (1998) but not in earlier studies near Beograd (Senćanski 1972, Obušković *et al*. 1987). Martinović-Vitanović (1996) recorded *Cyclotella meneghiniana* however did not consider it dominant. Another dominant species *Stephanodiscus hantzschii* has not been considered dominant by Laušević *et al*. (1998) but was classified as dominant in the lower stretch of the Sava River by Senćanski (1972) and Martinović-Vitanović (1996) and Obušković *et al*. (1987). The same authors also recorded the frequent occurrence of *Aulacoseira granulata.* In this study diatoms dominated through the whole vegetation period with a relative abundance of 3-5. In August 2003 high water temperature and an extremely low water level were recorded at Jamena and coincided with a massive development of *Cyclotella meneghiniana* (relative abundance 9). Super saturation of oxygen was also recorded. Subdominant diatoms occurring in the lower Sava River were: *Fragilaria ulna*, *Fragilaria ulna var. acus*, *Fragilaria crotonensis*, *Nitzschia fruticosa*, *Diatoma vulgare*, *Melosira varians*, *Navicula cryptocephala*, *Navicula viridula, Asterionella formosa*. Green algae: *Scenedesmus quadricauda*, *S. acuminatus*, *Pediastrum simplex var. simplex*, *P. simplex var. echinulatum*, *Actinastrum hantzschii* and *Micractinium pusillum* were subdominant during summer (relative abundance 3). In general the phytoplankton of the lower stretch of the Sava River is less abundant than the phytoplankton of the Danube river on the stretch through Serbia (Čađo, 2006). This general low abundance was also reflected by the irregular occurrence of phytoplankton species in 2004. The high water level during 2004 probably reduced phytoplankton development. Cyanoprokaryota that form water blooms and are potentially toxin-producing occured periodically, especially in summer period, but with a small relative abundance (1-2). Consequently, the increased phosphate concentrations did not result in higher phytoplankton production probably due to the distinctive characteristics of the Sava River water regime, i.e. significant increases in discharge. Within 24 h the discharge at Sremska Mitrovica can increase by 1070 $m^3$ $sec^{-1}$ resulting in an increase of the water level by 154 cm (Gavrilović 2002). The following increase in concentrations of suspended solids may also reduce phytoplankton growth. All results together indicate β-mesosaprobic conditions.

**Summary**

Results of this study document slight organic pollution of water in the Sava River with high concentrations of dissolved oxygen in the water. Concentrations of ammonia and nitrate were low, however concentrations of nitrites, total nitrogen, orthophosphates and total phosphor were found increased on a few sampling sites. A great heterogeneity of phytoplankton was observed, with a dominance of diatoms during the whole vegetation period. Green algae were subdominant during summer. In general low phytoplankton concentrations were recorded throught the study period. The Sava River hydrological water regime consisting of abrupt changes in discharge and large oscillations of the water level) probably prevents intense phytoplankton growth. The index values indicate β-mesosaprobic conditions (class II).

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