

## EUGLENOPHYTA OF THE DANUBE RIVER IN SERBIA

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**Abstract** — Most genera and many species of euglenophytes exist worldwide. They usually occur during the summer months in slow-flowing and stagnant waters, rich with organic substances. Euglenophytes of the Danube River in Serbia were studied at 16 localities during 2002-2003. A total of 61 taxa were found, 21 belonging to the genus *Euglena* Ehr., eight to *Lepocinclis* Perty, 15 to *Phacus* Duj., six to *Strombomonas* Defl., and 11 to *Trachelomonas* Ehr. The highest number of taxa (35) was recorded at Bačka Palanka during September 2002, but at the Tekije locality no euglenophytes were detected at all.

**Key words:** Danube, Serbia, Euglenophyta

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## INTRODUCTION

The Danube River enters the territory of Serbia from Hungary at its 1433<sup>th</sup> km and leaves it at its 845<sup>th</sup> km, after the mouth of the Timok River. In Serbia, the Danube flows mostly through plains. When the Djerdap Hydroelectric Power Plant was constructed in 1972, the Djerdap Reservoir was formed. The presence of Euglenophyta was first found in the Serbian section of the Danube by Protić in 1939. Milovanović and Živković (1950, 1965) and Obušković (1977, 1984, 1994) contributed the most to knowledge of Euglenophyta in the Danube, while other authors noted the individual presence of a small number of taxa (Maletin et al., 1994; Simić et al., 1997; Nemeth et al., 2002; Miljanović et al., 2003). More detailed studies of Euglenophyta in the Danube River in Serbia have not been done so far.

## MATERIALS AND METHODS

During 2002 and 2003, phytoplankton samples from the Danube were taken four or 12 times a year

in 16 localities: Bezdán (1), Apatin (2), Bogojevo (3), Bačka Palanka (4), Novi Sad (5), Slankamen (6), Čenta (7), Zemun (8), Pančevo (9), Smederevo (10), Banatska Palanka (11), Veliko Gradište (12), Dobra (13), Tekija (14), Brza Palanka (15), and Radujevac (16). Physico-chemical analyses of water were performed according to standard analytic methods (APHA AWWA WEF, 1998; JUS-ISO) at the Republic Hydrometeorological Service of Serbia. Samples for qualitative analyses of Euglenophyta were taken with a No. 22 plankton net and fixed with 4% formaldehyde solution. Identification of algae was performed using a Reichart Distar<sup>TM</sup> microscope equipped with a Canon Power Shot S40 digital camera. Species of the division Euglenophyta were identified according to Popova (1966), Starmach (1983), Nemeth (1997a, 1997b), and Wolowski (1998). The samples were deposited for storage in facilities of the Institute of Botany and Jevremovac Botanical Garden, Faculty of Biology, University of Belgrade, Belgrade. The list of all taxa is arranged on the basis of the classification system according to Ledale (1967).

**Table 1.** Physico-chemical characteristics of water of the Danube River.

Parameters	Unit	min.	max.	aver.	Parameters	Unit	min.	max.	aver.
Water t	°C	1	26	13	Total-N	mg/l	1.6	4.6	2.57
Air t	°C	-4.6	30	14	SO <sub>4</sub> <sup>2--</sup>	mg/l	12	55	33
pH		7.2	8,6	8	Cl <sup>-</sup>	mg/l	11	28	18
Conductivity	µS cm <sup>-1</sup>	262	548	397	PO <sub>4</sub> <sup>3--</sup> -P	mg/l	0.005	0.172	0.058
Free CO <sub>2</sub>	mg/l	0	18	3	Total-P	mg/l	0.052	0.313	0.118
HCO <sub>3</sub>	mg/l	123	238	192	Ca	mg/l	37	70	54
CaCO <sub>3</sub>	mg/l	122	238	162	Mg	mg/l	3	22	13
Dissolved O <sub>2</sub>	mg/l	5.3	16	10	Hard.CaCO <sub>3</sub>	mg/l	19	327	189
Saturation O <sub>2</sub>	%	57	168	87	Na	mg/l	6	22,3	14
BOD <sub>5</sub> -O <sub>2</sub>	mg/l	1	7	2.9	K	mg/l	0,8	3,2	2,1
Suspended matter	mg/l	1	155	20	SiO <sub>2</sub>	mg/l	1	12	5
NH <sub>4</sub> -N	mg/l	0.02	1.03	0.18	Fe	mg/l	0.067	0.244	0.140
NO <sub>3</sub> -N	mg/l	0.2	3.26	1.77	Mn	mg/l	0.009	0.094	0.035
NO <sub>2</sub> -N	mg/l	0	0.14	0.03	Pb	µg/l	0	9	3
Organic N	mg/l	0	2.2	0.58	Cu	µg/l	0	98	21

## RESULTS

The results of measuring physical and chemical variables at the sampling sites are summarized in Table 1. Water temperature varied from 1 to 26°C (Table 1). The water had pH values varying from neutral (pH = 7.2) to slightly alkaline (pH = 8.6). The Danube's water is mostly semi-hard, well aerated (10.2 O<sub>2</sub> mg/l), and without organic pollution (BOD<sub>5</sub> = 2.9 mgO<sub>2</sub>/l). The concentrations of nutrients and of nitrogen and phosphorus compounds are within the limits of classes I and II according to the TNMN five-level classification of water quality recommended by ICPDR (Anon., 2001), except for occasional increased concentrations of nitrites (max 0.136 mg/l) and total nitrogen (max 4.6 mg/l). The average concentration of analyzed metals according to the same classification belongs to the II/III water quality class.

## DISCUSSION

The highest diversity of this division was recorded at the Bačka Palanka locality (as many as 35 taxa), but not a single taxon was recorded at the Tekije locality. In this investigation, 40 new taxa were found in the Danube, 18 of which are new to the algal flora of Serbia (Subakov-Simić, 2006). The highest number of taxa per single sample was noted at

the Bačka Palanka locality on September 11, 2002, when the presence of 21 taxa of the Euglenophyta division was recorded. The most frequently found taxa were *E. viridis* (at eight localities) and *T. volvocina* (at six localities).

So far, 74 taxa of this division have been recorded in the Danube on the territory of Serbia (Subakov-Simić, 2006). As many as 36 taxa noted in earlier studies (Protić, 1939; Milovanović and Živković, 1950, 1965; Obušković, 1977, 1984, 1994; Maletin et al., 1994; Simić et al., 1997; Nemeth et al., 2002; Miljanović et al., 2003; Đurković and Čađo 2004, Čađo et al., 2005) were not recorded in this investigation, indicating great variability and instability of Euglenophyta communities in the Danube. Taxa belonging to this division are quantitatively very rare in the Danube phytoplankton community. Their highest abundance was recorded during summer, which is also confirmed by other references (Montesanto et al., 2000). The following species were found in the greatest numbers: *Euglena viridis*, *Phacus pyrum*, *Trachelomonas volvocina*, and *T. pleuronectes*. Taxa belonging to this division primarily inhabit stagnant water, such as that of ponds, swamps, lakes, canals, and ditches. Greater water turbulence in the river ecosystem and the presence of an increased quantity

**Table 2.** List of Euglenophyta taxa of the Danube River in Serbia during 2002/03 (\* taxa recorded for the first time in the Danube in Serbia)

Taxa	Taxa
<i>Euglena acus</i> var. <i>acus</i> EHR.	* <i>Ph. asymmetricus</i> SOKOLOFF
* <i>E. acus</i> var. <i>hyalina</i> KLEBS	<i>Ph. curvicauda</i> SWIR.
* <i>E. anabaena</i> MAINX	<i>Ph. helicoides</i> POCHM.
* <i>E. caudata</i> HÜB.	<i>Ph. longicauda</i> (EHR.) DUJ.
* <i>E. clavata</i> SKUJA	<i>Ph. longicauda</i> var. <i>tortus</i> LEMM.
<i>E. ehrenbergii</i> KLEBS	* <i>Ph. meson</i> POCHM.
* <i>E. gigas</i> DREZ.	<i>Ph. orbicularis</i> HÜB.
* <i>E. gracilis</i> KLEBS	* <i>Ph. orbicularis</i> fo. <i>communis</i> POP.
<i>E. intermedia</i> (KLEBS) SCHMITZ	* <i>Ph. orbicularis</i> fo. <i>gigas</i> (da CUN.) POP.
* <i>E. limnophila</i> LEMM.	<i>Ph. pleuronectes</i> (MÜLLER) DUJ.
* <i>E. oblonga</i> SCHMITZ	<i>Ph. pyrum</i> (EHR.) STEIN
<i>E. oxyuris</i> SCHMAR.	* <i>Ph. tortuosus</i> ROLL
* <i>E. pascheri</i> SWIR.	* <i>Ph. undulatus</i> (SKVOR.) POCHM.
* <i>E. rostrifera</i> L.P. JOHN.	* <i>Strombomonas acuminata</i> (SCHMAR.) DEF.
* <i>E. spirogyra</i> var. <i>lacticlavius</i> HÜB.	* <i>S. eurystoma</i> var. <i>incurva</i> (BUCH.) POP.
* <i>E. spirogyra</i> var. <i>minor</i> ALL. & LEF.	* <i>S. fluviatilis</i> var. <i>levis</i> (LEMM.) SKV.
* <i>E. stellata</i> MAINX	* <i>S. planctonica</i> (WOLOSZ.) POP.
* <i>E. texta</i> (DUJ.) HÜB.	* <i>S. praeliariis</i> (PALM.) DEF.
* <i>E. tuberculata</i> SWIR.	* <i>S. tuberosa</i> var. <i>conspersa</i> SKVORT.
* <i>E. variabilis</i> KLEBS	* <i>Trachelomonas bacillifera</i> var. <i>minima</i> PLAY.
<i>E. viridis</i> EHR.	* <i>T. dybowskii</i> DREZ.
<i>Lepocinclis elongata</i> (SWIR.) CONR.	<i>T. hispida</i> (PERTY) STEIN
* <i>L. fusiformis</i> (CARTER) LEMM.	* <i>T. intermedia</i> DANG.
* <i>L. globula</i> PERTY	* <i>T. manginii</i> DEF.
* <i>L. marssonii</i> LEMM.	* <i>T. nigra</i> SWIR.
* <i>L. nayali</i> CONR.	<i>T. oblonga</i> LEMM.
<i>L. ovum</i> (EHR.) LEMM.	* <i>T. patellifera</i> POP.
* <i>L. playfairiana</i> DEFL.	<i>T. planctonica</i> SWIR.
<i>L. salina</i> FRITSCH	* <i>T. verrucosa</i> var. <i>irregularis</i> DEF.
<i>Phacus</i> DUJ. sp.	<i>T. volvocina</i> EHR.
<i>Ph. acuminatus</i> STOKES	

of suspended matter, especially during the spring and autumn periods of high water, cause mechanical damage to cells and lower photosynthesis due to decreased transparency, thereby reducing qualitative and quantitative diversity of the Euglenophyta community.

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## EUGLENOPHYTA REKE DUNAV U SRBIJI

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Већина родова и врста Euglenophyta су широко распрострањене. Обично их срећемо током летњих месеци у споротекућим и стајаћим водама које су богате органским супстанцама. Током 2002-2003 године истраживане су *Euglenophyta* Дунава у Србији на 16 локалитета. Укупно је утврђено присуство

61 таксона, од којих 21 таксон *Euglena* Ehr., 8 *Lepocinclis* Perty, 15 *Phacus* Duj., 6 *Strombomonas* Defl., 11 *Trachelomonas* Ehr. Највећа разноврсност по броју таксона забележена је на локалитету Бачка Паланка (35) у септембру, док на локалитету Текија није забележено присуство припадника овог раздела.