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BIOLOGICAL AND SAPROBIC EXAMINATION OF THE GRAVEL PIT ADJACENT TO DOKI SITE

IVAN HABDIJA, MARIJA TOMEC and RADOVAN ERBEN

(Faculty of Science, University of Zagreb)

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Introduction

Numerous water accumulations have been built for various purposes: hydroelectric power stations, irrigations, fisheries, water supplies for the communities, recreation and others.

A special type of water accumulation being built mechanically is the gravel pit. In the SR Croatia there are very few data on biological and saprobic examinations of such biotopes. Many authors (Malosejа et al. 1973, Crc and Munjko 1974, Pavletić et al. 1974, Habdija and Erben 1973) studied water accumulations of larger magnitudes (Omladinsko and Bajer lakes in Gorski Kotar).

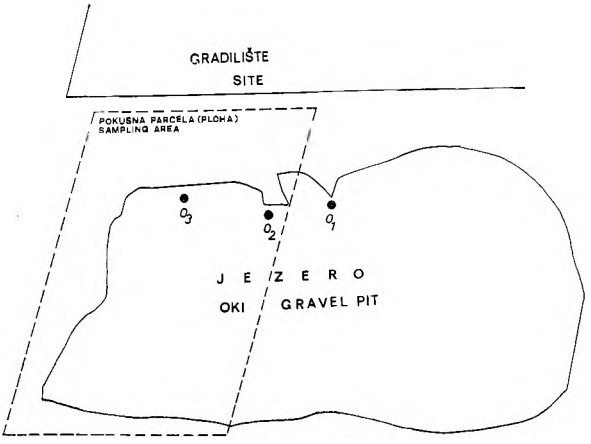
The subject of our examinations was the gravel pit within the plant site of the Organic Chemical Industry (OKI), Zagreb*.

Area of Examination and Methods

The gravel pit is located at the eastern edge of Zagreb, in the Žitnjak area, between the railroad Čulinec — Velika Gorica and the main sewer collector Zagreb — Ivanja Rijeka, within the plant fence and in the area of the old river Savica. The depression obtained by mechanization is filled with water in the approximate area of 6 hectars (approximately 15 acres). The shore length of the lake is 1900 m and the average depth is 4 m. The water level of the gravel pit follows those of the river Sava and Žitnjak underground waters. Fish have been planted in the gravel pit and it is used as a sport fishing resort for OKI's personnel and in case of water shortages, as a source of fire water and addition to the cooling water stream used in the plant.

* The investigations on the OKI gravel pit were performed with financial help of DOKI factory.

Since the construction of a new polystyrene plant, DOKI (a joint venture of OKI and The Dow Chemical Company) is in progres in the vicinity of the gravel pit examinations were needed to establish the reference data wich should serve to determinate to what extent this construction and later plant operations would affect the water quality and the gravel pit surrounding.



Sl. 1. Položaj ispitivanih točaka u šljunčari
Fig. 1. Position of the sampling points

The biocenological examination of the benthos and plankton at three locations O_1, O_2 and O_3 (Fig. 1) was completed in December 1975. Samples of benthos and plankton were taken qualitatively and quantitatively. Quantitative samples of benthos were collected along the shore using the net by Surber (1934), and qualitative samples were taken with an ordinery benthos net, 4 — 5 meters from the shore. Zooplankton was collected with a plankton net having pore opening of 112 microns, and phytoplankton with a plankton net having pore openings of 40 microns. For the quantitative sampling of zooplankton at every sampling station 100 liters of water was filtered.

The samples were immediately transferred to the laboratory, where the fresh material was used for partial determination of species. The material preserved in 4% formaldehyde was analysed over the period of the following 20 days.

The presence of individual species is given according to the scale of K n ö p p (1954) and represented by the numbers 1—7.

The saprobiological index after Rotschein (S_R — saprobiological index) 1962., and the saprobiological evaluation after Z e l i n k a & M a r v a n 1961., on the basis of phytoplankton, zooplankton and phytobenthos indicators, is given.

Results and Discussion

Quantitative and Qualitative Structure of Zooplankton

The total quantitative and relative (pct) structure of zooplankton from station O_1 is presented in Table 1., and the qualitative and relative (ptc) structures of zooplankton from stations O_2 and O_3 are listed in Tables 2 and 3.

In the zooplankton sample from O_1, 4 species of *Rotatoria*, 5 species of *Cladocera*, 2 species of *Copepoda* and 2 species of *Bryozoa* were found. The most predominant is the group of crabs *Cladocera* with 142 units in 100 liters of water, amounting to 46% of total zooplankton representative found. The group of crabs *Copepoda* is represented with 31 individuals in 100 l of water, amounting to 10.23%. The larvae of lower crabs (*nauplia*) are significant. There are 55 individuals in 100 l of water, amounting to 18.55% of the total number of zooplankton organisms. It follows that lower crabs are the predominant group of the zooplankton from station O_1.

The analysis of the sample from station O_2 gave one representative of *Nematoda* but the species was not determined, 3 species of *Rotatoria*, 5 species of *Cladocera*, one *Copepoda*, 2 species of *Bryozoa* and larvae

Table 1. Quantitative Structure of Zooplankton and Relative Amounts of Species from Station 0_1, December 1975.

Tabela 1. Kvantitativna struktura zooplanktona i procentualni odnosi vrsta na postaji 0_1, u prosincu 1975.

Species Vrste	Number of individuals in 100 l Broj jedinki u 100 l	Pct (%) Procentualni odnos (%)
Rotatoria		
Asplanchna girodi De Guerne	5	1.65
Brachionus angularis Gosse	25	8.25
Keratella cochlearis Gosse	34	11.22
Polyarthra remata Skorikov	11	3.63
Cladocera		
Alona rectangula Sars	9	2.97
Bosmina longirostris O. F. Müller	14	4.62
Ceriodaphnia quadrangula O. F. M.	17	5.61
Chydorus sphaericus O. F. M.	98	32.34
Moina sp.	4	1.32
Copepoda		
Acanthocyclops sp. (development stage)	24	2.31
Diaptomus sp. ,, ,,	7	2.31
Larvae of lower crabs-nauplia	55	18.15
Bryozoa		
Plumatella fungosa Pall. — statoblasts	many	
Plumatella repens L. — statoblasts	many	

Table 2. Qualitative Structure of Zooplankton and Relative Amounts of Species from the Station 0_2, December 1975.

Tabela 2. Kvalitativna struktura zooplanktona i procentualni odnos vrsta na postaji 0_2 u prosincu 1975.

Species Vrste	Percentage (%) Procentualni odnos (%)
Nematoda	5.51
Rotatoria	
Asplanchna girodi De Guerne	0.78
Brachionus angularis Gosse	2.36
Keratella cochlearis Gosse	3.93
Cladocera	
Alona rectangula Sars	2.36
Bosmina longirostris O. F. Müller	1.57
Ceriodaphnia quadrangula O. F. M.	6.29
Chydorus sphaericus O. F. M.	59.05
Moina sp.	2.36
Copepoda	
Diaptomus sp. (development stage)	2.36
Larvae of lower crabs — nauplia	13.38
Bryozoa	
Plumatella repens L. — statoblasts	many
Plumatella fungosa Pall. — statoblasts	many

of lower crabs. The most represented species is *Chydorus sphaericus* O. F. M. *(Cladocera)*, 59.05% of the total zooplankton organisms from the station O_2.

As shown in Table 3., station O_3 has almost the same representatives from the groups *Nematoda, Cladocera, Copepoda, Bryozoa,* and the larvae of lower crabs as stations O_1 and O_2. The most represented species are *Chydorus sphaericus* from the group *Cladocera* with 34,51% and the larves of lower crabs with 23%.

Qualitative Structure of Phytoplankton

Table 4. shows the qualitative structure of phytoplankton from the stations O_1, O_2 and O_3.

Among the phytoplankton organisms, there are members of 3 phylum; *Cyanophyta* (Blue — Green Algae), *Chrysophyta* (Golden Algae), and *Chlorophyta* (Green Algae).

There are 6 species of *Cyanophyta*. The most common species is the *Oscillatoria irrigua,* with a frequency of 4. A less common species is the *Microcystis flos-aquae,* with a frequency of 2. Species *Oscillatoria amoena, Os. deflexoides, Phormidium luridum* and *Ph. valderiae* are presented as sole members.

Relative to the number of species present, the predominant algae are the *Chrysophyta*. About 24 species belong to the class *Diatoms* (*Bacillariophyceae*). The predominant species is the *Navicula rhynchocephala*

Table 3. Qualitative Structure of Zooplankton and Relative Amounts of Species from the Station 0_3, December 1975.

Tabela 3. Kvalitativna struktura zooplanktona i procentualni odnos vrsta na postaji 0_3, u prosincu 1975.

Species Vrste	Percentage (%) Procentualni odnos (%)
Nematoda	11.50
Rotatoria	
Asplanchna girodi De Guerne	2.65
Brachionus angularis Gosse	3.53
Keratella cochlearis Gosse	0.88
Polyarthra remata Skorikov	0.88
Cladocera	
Alona rectangula Sars	3.53
Ceriodaphnia quadrangula O. F. M.	4.42
Chydorus sphaericus O. F. M.	34.51
Daphnia longispina O. F. M.	0.88
Moina sp.	1.76
Copepoda	
Acanthocyclops sp. (development stage)	6.19
Diaptomus sp. (development stage)	6.19
Larve of lower crabs — nauplia	23.00
Bryozoa	
Plumatella repens L. — statoblasts	many
Plumatella fungosa Pall. — statoblasts	many

with a frequency 4. Besides those, there are some other species with a frequency of 3, like *Fragilaria crotonensis, Navicula lanceolata, N. radiosa, Nitzschia paleacea,* and *Synedra ulna var. danica.* The remaining species found are either very small in number or single.

The *Clorophyta* division is represented by 2 species, *Scenedesmus obliquus* and *Sc. quadricauda,* which are sole members.

Qualitative Structure of Phyto- and Zoobenthos

According to the number of species phytobenthos is considerably more developed than zoobenthos. Table 5. indicates that phytobenthos consists mostly of *Chrysophyta* (46 species) with the species *Navicula rhynchocephala, Na. radiosa,* and *Synedra ulna var. danica* dominating. Somewhat less represented are species *Amphora ovalis, Achnanthes nodosa, Cyclotella comta, Cymbella amphicephala, C. ventricosa, Fragilaria crotonensis, Gyrosigma attenuatum, Navicula cryptocephala, N. lanceolata, Nitzschia capitellata, Nitz. kuetzingiana* and *Stauroneis anceps.* Other species were found single.

Table 4. Qualitative Structure of Phytoplankton from Stations 0_1, 0_2 and 0_3, December 1976.

Tabela 4. Kvalitativna struktura fitoplanktona na postajama 0_1, 0_2 i 0_3, u prosincu 1975

Species Vrste	Frequency Učestalost
Chyanophyta	
Microcystis flos-aquae Kirch	2
Oscillatoria amoena Gom.	1
Os. deflexoides Elenk. et. Kos.	1
Os. irrigua Kütz.	4
Phormidium luridum Gom.	1
Ph. valderiae Geitl.	1
Chrysophyta	
Diatomeae	
Achnanthes nodosa A. Cl.	1
Amphora ovalis Kütz.	1
Cyclotella stelligera Cl.	1
Cymbella amphicephala Näg.	2
Cy. ventricosa Kütz.	1
Fragilaria crotonensis Kitt.	3
Navicula cryptocephala Kütz.	1
Na. falaisiensis Grun.	1
Na. gracilis Ehr.	1
Na. lanceolata Kütz.	1
Na. pupula var. rostrata Hust.	1
Na. radiosa Kütz.	3
Na. rhynchocephala Kütz.	4
Na. viridula Kütz.	1
Nitzschia acicularis W. Sm.	1
Ni. capitellata Hust.	2
Ni. dissipata Grun.	1
Ni. heufleriana Grun.	2
Ni. paleacea Grun.	3
Ni. sigmoidea W. Sm.	1
Ni. subtilis Grun.	1

The blue-green algae (*Cyanophyta*) are represented with 10 species, and the dominating species from genus *Phormidium* are *Phormidium luridum, Ph. valderiae, Ph. papyraceum* and *Ph. ambiguum.*

Of the green algae (*Chlorophyta*) 8 species were found. Genus *Scenedesmus* was represented by 5 species, genus *Pediastrum* by 1, and genus *Staurastrum* by 2 species. All species were found single except *Scenedesmus quadricauda* which is somewhat better represented than the others.

According to the number of species zoobenthos was less represented than phytobenthos. It was limited to the *Oligocheaeta, Cladocera* (lower crabs), *Copepoda* (lower crabs) groups, and insects larvae of the orders *Ephemerida, Trichoptera* and *Diptera* which were either single or scarcely present. The most represented species was *Alona rectangula (Cladocera),* with the frequency of 6.

Saprobic Status of the Gravel Pit

Of the animal and plant species found, only a few can be considered biological indicators. Table 6. lists such species with a complete indicator values in the corresponding limnosaprobic zones.

Phytobenthos and Phytoplankton representatives mainly belong to the beta — mesosaprobic degree, while zooplankton belongs to oligosaprobic and beta-mesosaprobic degree of limnosaprobity.

Phytoplankton representatives show the saprobiological index after Rotschein (S_R) 51.3 and saprobic stage after Zelinka — Marvan 5.3. Zooplankton indicates the S_R 62.3 and saprobic stage 4.1, while phytobenthos shows the S_R 53.3 and saprobic stage after Zelinka — Marvan 5.5.

The total saprobiological evaluation of the gravel pit examined shows that the points investigated belonged to the beta-mesosaprobic stage of limnosaprobity at the time of the examinations.

Conclusion

Qualitative and quantitative zoocenological and phytocenological examinations of plankton and benthos from the three points near the shore line of the OKI gravel pit were carried out in December 1975 (Fig. 1).

The Plankton consisted of 13 representatives of zooplankton of which 4 species were from the class *Rotatoria,* 7 species from the class *Crustacea* from the order *Cladocera* and *Copepoda,* and 2 species of *Bryozoa* (Table 1).

Phytoplankton was represented by a greater number of species; a total of 32 species were found, 6 from division *Cyanophyta,* 24 from division *Chrysophyta,* and 2 species from division *Chlorophyta* (Table 4).

Species of phytobenthos were even more numerous. In total, 65 species of algae were found: 10 species from division *Cyanophyta,* 46 species from division *Chrysophyta,* and 8 species from division *Chlorophyta* (Table 5).

In the samples of zoobenthos, certain species of crabs were found which are usually found in plankton; the dominating species was *Alona rectangula* from the order *Cladocera.* Other groups of animals *Oligochaeta* and insect larvae were found in small numbers only. This conclusion does not rule out the existence of a considerably larger number of zoobenthos species in other seasons. Therefore the results obtained indicate the situation at the time of the examination only.

The saprobiological evaluation of the gravel pit examined indicated that the sampling points belonged to beta-mesosaprobic degrees according to the saprobity level by Zelinka & Marvan (Table 7).

In order to obtain a more complete insight into the dynamics of the living processes in the biotop examined, such examinations should be carried out more frequently at time intervals of 1 year minimum.

For the determination of possible influences on the structure of the living communities, which the newly built polystyrene plant might exert, additional local and laboratory examinations 1 to 2 years after the start are needed.

Table 5. Qualitative Structure of Phyto- and Zoobenthos from Stations 0_1, 0_2 and 0_3, December 1975.

Tabela 5. Kvalitativna struktura fito- i zoobentosa na postajama 0_1, 0_2 i 0_3 u prosincu 1975.

Species Vrste	Frequency Učestalost
PHYTOBENTHOS	
Cyanophyta	
Lyngbya martensiana Menegh.	1
Merismopedia punctata Neyen	1
Microcystis flos-aquae Kirch.	1
Oscillatoria deflexoides Elenk. et Koss.	1
Os. irrigua Kütz.	2
Phormidium ambiguum Gom.	1
Ph. papyraceum Gom.	3
Ph. luridum Gom.	2
Ph. valderiae Geitl.	3
Spirulina subtilissima Kütz.	1
Chrysophyta	
Dinobryon divergens Imh.	1
Achnanthes microcephala Grun.	1
Ac. nodosa A. Cl.	2
Amphora ovalis Kütz.	3
Caloneis silicula Cl.	1
Cocconeis placentuala var. intermedia Cl.	1
Cyclotella comta Kütz.	2
Cy. stelligera Cl. et Grun.	1
Cymatopleura solea W.	1
Cymbella affinis Kütz.	1
Cy. amphicephala Näg.	2
Cy. cymbiformis W. H.	1
Cy. ventricosa Kütz.	2
Eucocconeis flexella Kütz.	1
Eunotia exigua var. compacta Hust.	1
Eu. veneris O. Müll.	1
Fragilaria crotonensis Kitt.	2
Fr. leptostauron Hust.	1
Gomphonema olivaceum Kütz.	1
Go. olivaceum var. calcareum Cl.	1
Go. parvulum Grun.	1
Go. parvulum var. lagenulum Hust.	1
Gyrosigma attenuatum W. Sm.	2
Gy. kuetzingii Cl.	1
Navicula cryptocephala Kütz.	2
Na. dicephala W. Sm.	1
Na. lanceolata Kütz.	2
Na. gracilis Ehr.	1
Na. oblonga Kütz.	1
Na. pupula var. rostrata Hust.	1
Na. radiosa Kütz.	5
Na. rhynchocephala Kütz.	5
Na. rostellata Kütz.	1
Nitzschia acicularis W. S	1
Ni. capitellata Hušt.	2
Ni. kuetzingiana Hilse	2

▶

Species Vrste	Freqvency Učestalost
Ni. palea W. Sm.	1
Ni. paleacea Grun.	1
Pinnularia viridis uhr.	1
Staćroneis anceps Ehr.	2
St. anceps f. gracilis Cl.	1
Surirella robusta Ehr.	1
Synedra ulna Ehr.	1
Sy. ulna var. danica Grun.	4
Sy. ulna var. biceps Schaf.	1
Tribonema minus Hazen	1
Cholorophyta	
Pediastrum boryanum (*Turp.*) Menegh.	1
Scenedesmus abundans Ch.	1
Sc. bijugatus Kütz.	1
Sc. disciformis Fott. et Ko.	1
Sc. obliguus Kütz.	1
Sc. quadricauda Breb.	2
Staurastrum dejectum Breb.	1
St. polymorphum Breb.	1
ZOOBENTHOS	
Oligochaeta	2
Cladocera	
Alona rectangula Sars	6
Copeopda	
Cyclops sp.	2
Ostracoda	
Cypridopsis vidua O. F. Müller	2
Ephemerida (larva)	1
Trichoptera (larva)	1
Chironomida	
Polypedilum sp.	1
Limnlchironomus gr. tritomus Niefb.	2
Cryptochironomus sp.	2
Ablabesmya gr. lentiginosa Fries.	1
Procladius	2

Table 6. Saprobiological Analysis of the OKI Gravel Pit December 1975.

Tabela 6. Saprobiologijska analiza šljunčare u prosincu 1975.

Species Vrste	Indicator Value Indikatorska vrijednost					
	x	o	b	a	p	G
Fitoplankton Phytoplankton						
Microcystis flos-aquae Kirch.		1	8	1		4
Amphora ovalis Kütz.	1	3	4	2		1
Cymbella ventricosa Kütz.	2	4	3	1		1
Fragilaria crotonensis Kitt.		6	4			3
Navicula cryptocephala Kütz.			3	7		4
Na. gracilis Ehr.		4	5	1		2
Na. radiosa Kütz.		4	6			3
Na. viridula Kütz.			2	8		4
Nitzschia acicularis W. Sm.			3	7		4
Ni. dissipata Grun.		5	5			3
Ni. heufleriana Grun.		4	6			3
Ni. sigmoidea W. Sm.		1	8	1		4
Scenedesmus obliguus Kütz.			7	3		4
Sc. quadricauda Bréb.		2	6	2		3
Zooplankton						
Asplanchna girodi De Guerne		6	4			3
Brachionus angularis Gosse			5	5		3
Keratella cochlearis Gosse	2	5	3			2
Polyarthra remata Skorikov		10				5
Alona rectangula Sars		7	3			3
Bosmina longirostris O. F. Müller	1	4	4	1		1
Ceriodaphnia quadrangula O. F. M.	2	5	3			2
Chydorus sphaericus O. F. M.	1	3	4	1		1
Daphnia longispina O. F. M.		1	8	1		4
Fitobentos Phytobenthos						
Microcystis flos-aquae Kirchn.		1	8	1		4
Phormidium papyraceum Gom.		+	+			
Dinobryon divergens Imh.		2	7	1		3
Amphora ovalis Kütz.	1	3	4	2		1
Caloneis silicula Cl.		5	5			3
Cyclotella comta Kütz.	1	7	2			3
Cymatopleura solea W. Sm.		1	5	4		2
Cymbella affinis Kütz.		4	6			3
Cy. ventricosa Kütz.	2	4	3	1		1
Gomphonema olivaceum Kütz.	1	3	3	3		1
Go. olivaceum var. calcareum Cl.			7	3		4
Go. parvulum Grun.	1	2	4	3		1
Gyrosigma attenuatum W. Sm.		2	8			4
Navicula cryptocephla Kütz.		+	3	7		4
Na. dicephala W. Sm.		+	+			
Na. gracilis Ehr.	+	4	5	1		2
Na. oblonga Kütz.		+	+			
Na. radiosa Kütz.		4	6	+		3
Na. rostellata Kütz.		8	2			4
Nitzschia acicularis W. Sm.			3	7		4

▶

▶

Species Vrste	Indicator Value Indikatorska vrijednost					
	x	o	b	a	p	G
Ni. palea W, Sm.			3	6	1	3
Pinnularia viridis Ehr.			9	1		5
Stauroneis anceps Ehr.			+			
Synedra ulna Ehr.	1	2	4	3	+	1
Sy. ulna var. biceps Shönf.		1	9			5
Tribonema minus Hazen	+	+	+			
Scenedesmus bijugatus Kütz.			10			5
Sc. obliquus Kütz.			7	3		4
Sc. quadricauda Brêb.		2	6	*h*2		3

Table 7. Saprobiological Evaluation of the Gravel Pit in December 1975.

Tabela 7. Saprobiologijska procjena šljunčare u prosincu 1975.

	x	o	b	a	p	G	Ocjena saprobnosti po Zelinka-Marvanu Saprobiological Evaluation after Zelinka-Marvan
Phytoplankton	0,1	2,6	5,3	2	—	51,3	beta (b = 5,3)
Zooplankton	0,6	4.1	4	1,3	—	62,3	oligo (o = 4,1)
Phytobenthos	0,1	2,7	5,5	1,6	0,1	52,3	beta (b = 5,5)
The average value and total saprobiological evaluation of the OKI gravel pit is 55.3 Srednja vrijednost i ukupna saprobiologijska procjena jezera OKI iznosi 55,3							beta

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SADRŽAJ

BIOLOGIJSKA I SAPROBIOLOGIJSKA ISTRAŽIVANJA ŠLJUNČARE NA GRAĐEVNOJ PARCELI DOKI

Ivan Habdija, Marija Tomec i *Radovan Erben*

(Prirodoslovno-matematički fakultet i Institut za botaniku Sveučilišta u Zagrebu)

U radu su izneseni podaci o kvalitativnim i kvantitativnim fitocenološkim i zoocenološkim istraživanjima na šljunčari u blizini Organsko-kemijske industrije u Zagrebu (DOKI), uz koju se gradi nova tvornica polistirena.

Odabrane su 3 karakteristične postaje na kojima su uzimani uzorci fitoplanktona i zooplanktona, te fitobentosa i zoobentosa. U planktonu smo utvrdili 13 predstavnika zooplanktona, dok je fitoplankton sa 32 vrste znatno bogatiji. U fitobentosu je nađeno 65 vrsti alga, a u zoobentosu samo nekoliko skupina životinja. Ti rezultati pokazuju samo trenutnu situaciju u vrijeme ispitivanja. Da bi se dobila potpunija slika o bogatstvu životnih zajednica, potrebno je istraživanja proširiti na period od najmanje godinu dana.

Izgradnjom nove tvornice polistirena na ovom području doći će do promjene u strukturi biocenoza. Da bi se ispitao utjecaj spojeva ove tvornice, potrebno je terenska i laboratorijska ispitivanja proširiti i na dulje periode.

Dr Ivan Habdija
Radovan Erben, mr biol.
Zoologijski zavod
Prirodoslovno-matematički fakultet
Sveučilišta u Zagrebu
Rooseveltov trg 6
Yu-41000 Zagreb (Jugoslavija)

Marija Tomec, mr. biol.
Botanički zavod
Prirodoslovno-matematičkog fakulteta
Sveučilišta u Zagrebu
Maruličev trg 20/II
Yu-41000 Zagreb (Jugoslavija)