I. A. D.

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The abundance, taxa richness and diversity of periphytic algae in the Szigetköz region 1991-1995.

BUCZKÓ, K. & ÁCS, É.

Abstract

Quality and quantity of the periphytic algae were investigated before and after the diversion of the main arm of Danube at two big branch-system of Szigetköz. Before the diversion 198 taxa, after it 108 taxa were recorded at Cikolasziget, and138 taxa before and 96 after the diversion were observed at Ásványráró respectively. While the number of taxa decreased the abundance increased, the diversity decreased at all the sampling points. Floristic changes also were detected.

Introduction

The periphytic algae are ideal organisms for biomonitoring (Whitton 1991). The algae have a short lifetime so they usually react fast to changes in their environment. The changes in the quantity of communities indicate the changes in their habitat. Most taxa of attached or periphytic algae are fixed to the substrata so their presence or absence and changes in their quantity are characteristic for the habitat.

Study area:

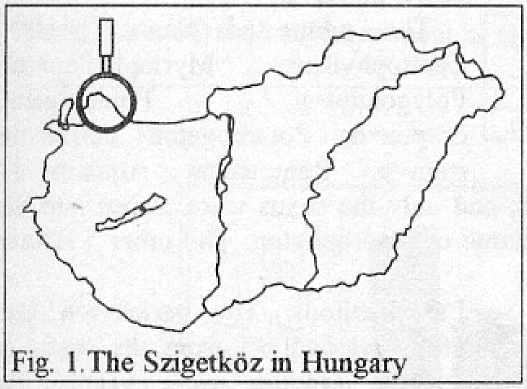

Fig. 1.The Szigetköz in Hungary

The Szigetköz is situated at the northwesten part of Hungary, where the Danube enters the Carpathian Basin (Fig.1.). Here, the large quick flowing river slows down, and the main arm of the river is divided many smaller arms. The Szigetköz is an island bounded by the main arm of the river (Old-Danube) and the Mosoni Danube. This island is 52 km long, on average 7-8 km wide its area is 375 sq. km.

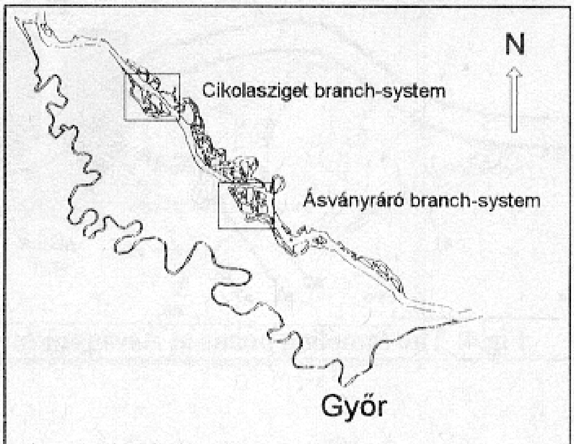

Fig.2. The Szigetköz region.

The Danube is the only Hungarian river which has an extended branch system. So Szigetköz stands alone for its value as an unique habitat.

The Hungarian and Czechoslovakian governments decided to build a water power plant to satisfy a growing energy demand in 70s. This region is endangered by the Bős-Nagymaros Barrage System.

Many experts drew attention to the series of very complex environmental processes resulting in predominantly negative degradative changes in the area. (Expert group... 1994). Owing to these risks shown by analyses and environmental impact assessments, the Hungarian party suspended construction in May of 1989. The Slovak party continued the construction, and a modified version - so called variant C - began to operate on 25th October 1992. The main arm (Old-Danube) was diverted, only a small portion of the total discharge (10-20 %) flow in the bed of Old-Danube. Consequently the Szigetköz branch-system lost most of their water supply and large areas became dry and the water level decreased in every branche. After the diversion 1992 a bit more water has been brought back to these branches, however the natural water level fluctuations are missing nevertheless.

Our investigations on the periphytic algae join to the Hungarian biomonitoring research in Szigetköz.

The references of previous algological work at Szigetköz (mainly on fitoplankton) available in Ács & Buczkó article in this volume.

Material and Methods

The samples were collected at 8 sampling points of the two big branch systems (Fig.2.) at Cikolasziget branch system = CBS (Fig 3.) and Ásványráró branch-system ÁBS (Fig.4.) before and after the diversion of Danube. The first two figure of the 8 places code of samples refer to the sampling points.

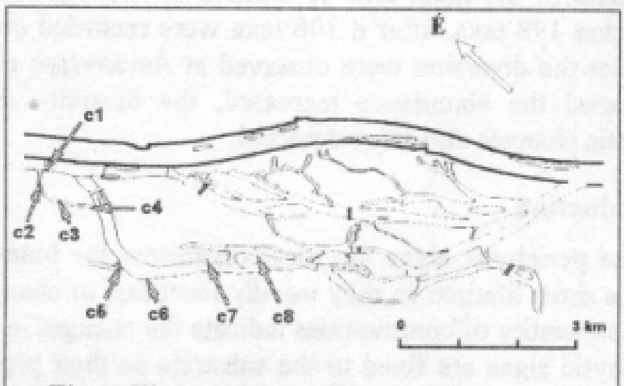

Fig.3. The sampling points at Cikolasziget

Sampling methods: The stem of macrophyta (Phragmites=n and Typha=g) were cut off at water level, and about 10 cm below this level.

Table 1.	Cikolasziget	Ásványráró
1991	13-15.07. and 07.09.	
1992		26.06.
1995	23.08 and 7.10.	23.08 and 7.10.

The submersed plants (Najas=j, Ceratophyllum=c, Myriophyllum=m, Polygonum=y, Potamogeton crispus=o, Potamogeton perfoliatus stem=p, Ranunculus Aquatilis=q,) were carefully taken off, the leaves were cut off, and only the stems were placed into the sampling jars. (The 3d figure of code gives the name of macrophyton. The other 5 figures give the date of the collection see Table.1)

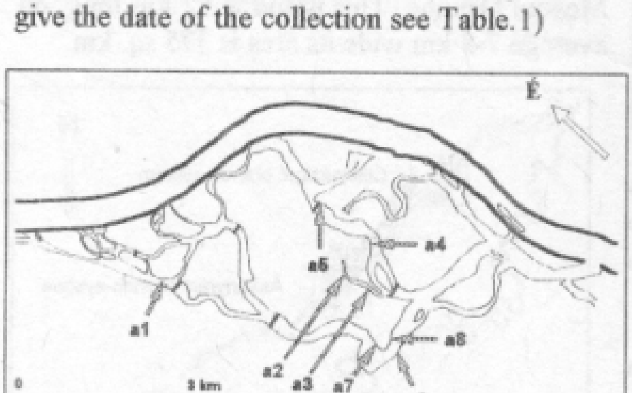

Fig.4. The sampling points at Ásványráró

Lab methods: The periphyton was carefully washed off from the stems in lab, these samples were handled as plankton samples. The abundance refers to the surface unit of stems. Diatoms were identified under light and scanning electron microscope, after the cleaning of the valves by H_2O_2. For statistical analysis SYN-TAX III. program was used (Podani 1988).

Results and discussion

The quantity of periphyton

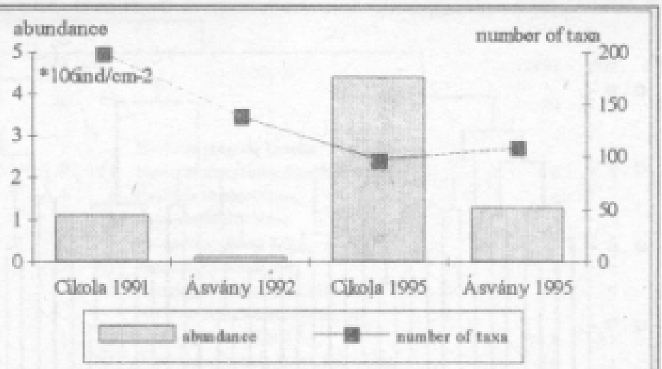

Fig.5. The changes of abundance and number of taxa

After the diversion the abundance of attached algae increased at both branch-system, in every sampling point (Fig. 5.). The average of abundance increased as well as the standard deviation, so the increase of maximum even more. At CBS about four times more attached algae lived in every macrophyton than in 1991. At ÁBS the abundance of attached algae increased about ten times. Moreover the density of macrophyta also increased, so the quantity of bentonic flora multiplied here. This means, the bentonic eutrophication became definitely obvious.

The increase of abundance was observable in summer and also in autumn. For example 2. Table show the changes of abundance according to seasons at CBS.

Table 2.	average of abundance $*10^6$	standard deviation	maximum $*10^6$	minimum $*10^6$	number of samples
1991 summer Cikolasziget	1.09	0.822	2.16	0.16	10
1991 autumn Cikolasziget	1.15	0.900	2.50	0.01	10
1995 summer Cikolasziget	3.82	3.219	10.74	0.14	10
1995 autumn Cikolasziget	5.21	3.894	10.48	0.50	8

Richness of taxa

A totale of 63 samples were analyzed during this study. Table 3. contains the taxa which occurred in more than 5 p.c. of samples.

Achnanthes minutissima was the most abundant and the most frequent species.

The number of taxa and the number of taxa/samples decreased in both branch system.

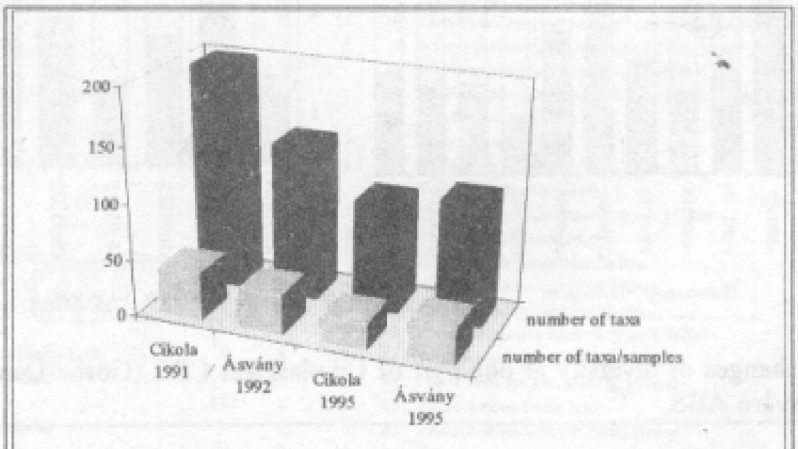

Fig. 6. The changes of number of taxa.

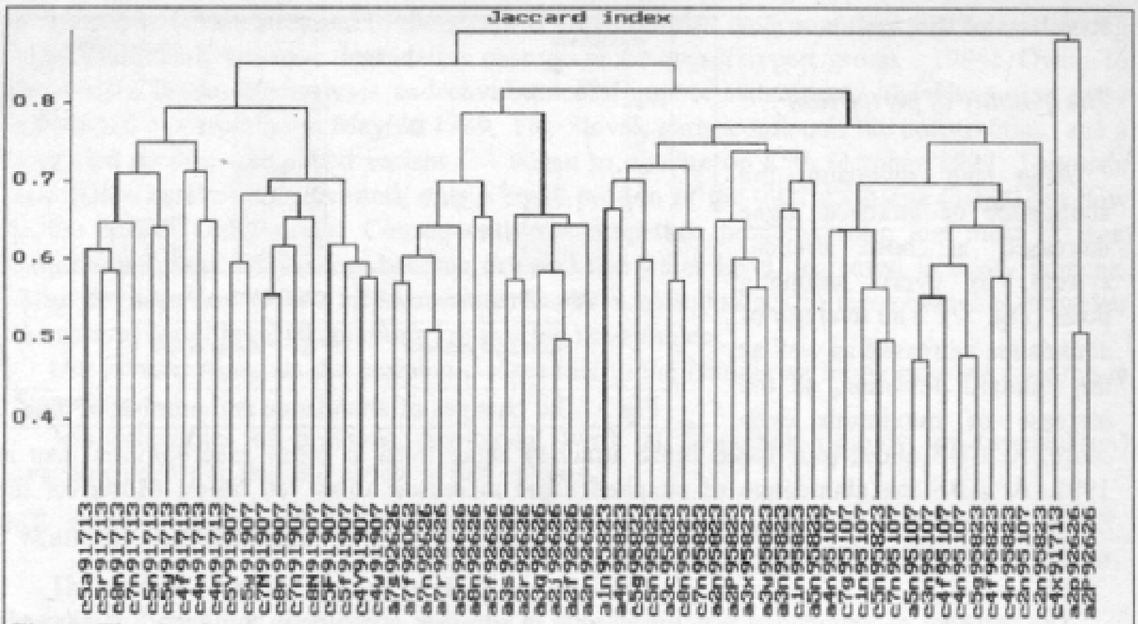

Fig. 7. The dendrogram of cluster analysis.

With the exeptions 3 samples the other 60 samples form clearly three groups (Fig. 7.). The first group contains the samples collected in 1991 at CBS. The second one consists of the samples of ÁBS in 1992. The third group contains the samples of 1995, here, the cluster analysis did not show separation according to the origine of the samples. The arrangements of groups refer to seasons instead of the sampling points.

It seems that, the formerly different floristic composition found at CBS and ÁBS disappeared until 1995 and the floristic composition of periphytic algae became uniform.

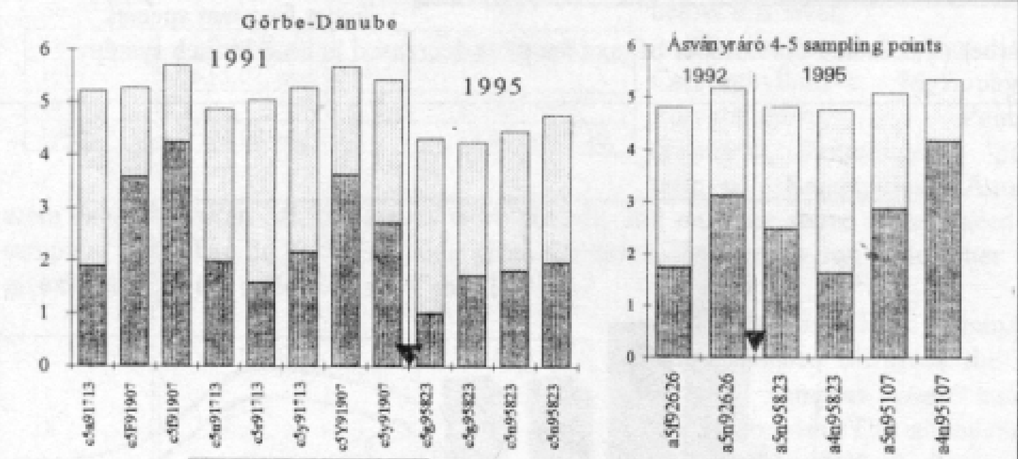

Fig. 8. The changes of diversity at one part of Cikolasziget CBS (Görbe-Danube), and at Ásványáró ÁBS.

Table 3. Taxa occurring in more than 5 p. c. of the samples

	1991	1992	1995	sum
number of samples	20	15	28	63
Cyanobacteria				
Anabaena catenulata (Kütz.) Born.&Flah.		2	9	11
Coelasphaerium kuetzingianum Näg.			4	4
Merismopedia glauca (Ehr.) Näg.	6		2	8
Merismopedia warmingiana Lagerheim	3	1	1	5
Planktolyngbya subtilis (W. West) Anagnostidis & K	18		25	43
Pseudanabaena catenata Lauterb.	15			15
Cryptophyta				
Cryptomonas erosa Ehr.	2	4		6
Cryptomonas ovata Ehrenberg	8	5		13
Chrysophyta, Chrysophyceae				
Chrysococcus rufescens Klebs	9			9
Dinobryon divergens Imhof	3	2		5
Dinobryon sertularia Ehr.	4	4		8
Chrysophyta, Bacillariophyceae				
Achnanthes delicatula (Kütz.) Grun.		4		4
Achnanthes lanceolata Bréb.	7	5	1	13
Achnanthes lanceolata var. rostrata Hust.	4			4
Achnanthes minutissima Kütz.	20	13	27	60
Achnanthes plönensis Hustedt	4	1	8	13
Amphora coffeaeformis (Agardh) Kützing			4	4
Amphora ovalis (Kütz.) Kütz.	5	4	10	19
Amphora pediculus (Kütz.) Grun.	14	5	19	38
Asterionella formosa Hass.	1	1	3	5
Aulacoseira distans (Ehr.) Kütz.	1	3	1	5
Aulacoseira granulata var. angustissima Müll.	1	1	3	5
Aulacoseira italica (Ehr.) Sim.		3	1	4
Aulacoseira italica var. tenuissima (Grun.) O. Müll.	7		1	8
Cocconeis pediculus Ehr.	16	6	17	39
Cocconeis placentula Ehr.	5	10	25	40
Cyclostephanos dubius (Fricke) Round	4			4
Cyclotella meneghiniana Kütz.	14			14
Cyclotella pseudostelligera Hust.	4			4
Cymatopleura solea (Bréb.) W. Smith	3		1	4
Cymbella affinis Kütz.	11	7	27	45
Cymbella aspera (Ehr.) Cleve	5	6		11
Cymbella caespitosa (Kütz.) Brun.	1	1	4	6
Cymbella cistula (Ehr.) Kirchner	1	2	2	5
Cymbella cymbiformis Agardh	5		4	9
Cymbella microcephala Grun.	5		11	16
Cymbella minuta Hilse ex Rabenhorst	16		2	18
Cymbella proxima Reimer			8	8
Cymbella silesiaca Bleisch		12	11	23
Diatoma tenuis Agardh	4	5		9
Diatoma vulgare Bory	9	6	11	26
Epithema adnata (Kütz.) Bréb.	4	1	1	6
Epithemia sorex Kütz.	3	1		4
Eunotia exigua (Bréb. ex Kütz.) Rabenhorst	4			4
Fragilaria brevistriata Grun.	8	9		17
Fragilaria capucina Desm.			7	7
Fragilaria capucina var. vaucheriae (Kütz.) Lange-Be	3	1	1	5
Fragilaria crotonensis Kitton		5		5
Fragilaria pinnata Ehr.	4	11	5	20
Fragilaria ulna (Nitzsch) Ehr.	20	9	9	38
Fragilaria ulna (Nitzsch) Lange-Bert. var. acus (Kütz.	13	9	5	27
Gomphonema acuminatum Ehr.	6	3	4	13
Gomphonema angustatum (Kütz.) Rabenhorst	1		11	12
Gomphonema minutum Agardh			8	8
Gomphonema olivaceum (Homemann) Bréb.	4	3	6	13
Gomphonema parvulum (Kütz.) Kütz.	17	11	13	41
Gomphonema truncatum Ehr.	11	1	7	19
Gyrosigma acuminatum (Kütz.) Rabh.	3	1	9	13
Melosira varians Ag.	13	8	13	34
Navicula capitatoradiata Germain			12	12
Navicula cryptocephala Kütz.	16	9	5	30

	1991	1992	1995	sum
	20	15	28	63
Navicula gregaria Donkin		4		4
Navicula margalithii Lange-Bertalot	9	2	19	30
Navicula minima Grun.	4			4
Navicula pupula Kütz.	2	2	1	5
Navicula pygmeae Kütz.	11			11
Navicula radiosa Kütz.	8	7	1	16
Navicula rhynchocephala Kütz.	16	7	11	34
Navicula subminuscula Manguin			4	4
Navicula veneta Kütz.	7	11	24	42
Nitzschia acicularis (Kütz.) W. Smith	10	1	2	13
Nitzschia amphibia Grun.	5	4	6	15
Nitzschia angustata Grun.	3	4	6	13
Nitzschia capitellata Hust.			4	4
Nitzschia dissipata (Kütz.) Grun.	7	5	17	29
Nitzschia fonticola Grun.	8		1	9
Nitzschia frustulum (Kütz.) Grun.		6	8	14
Nitzschia fruticosa Hust.	14	9		23
Nitzschia inconspicua Grun.		5		5
Nitzschia linearis (Agardh) W.Smith	14	3	10	27
Nitzschia palea (Kütz.) W. Smith	7		9	16
Nitzschia recta Hantzsch	5	4	8	17
Nitzschia sigmoidea (Nitzsch) W. Smith	6		2	8
Nitzschia sublinearis Hust.			4	4
Rhoicosphaenia abbreviata (Agardh) Lange	9	7	19	35
Skeletonema potamos (Weber) Hasle	4		3	7
Stephanodiscus hantzschii f. tenuis (Hust.) Hak et S	8			8
Stephanodiscus hantzschii Grun. f. hantzschii	4			4
Stephanodiscus invisitatus Hohn et Heller	6			6
Surirella ovalis Bréb.			5	5
Thalassiorisa pseudonana Hasle et Heimd	14			14
Chlorophyta				
Characium ensiforme Herm.	16	8	3	27
Characium ornithocephalum A.Br.	3	2	1	6
Chlamydomonas reinhardtii Dang.	9	13	9	31
Cladophora fracta (Dillw.) Kütz.	5			5
Cladophora glomerata (L.) Kütz.	1		3	4
Coelastrum microporum Näg.	2	9	1	12
Coelastrum sphaericum Näg.	3	1	4	8
Cosmarium granatum Bréb.	5		2	7
Crucigenia quadrata Morr.	2	5	2	9
Crucigenia tetrapedia (Kirchn.) W.&G.S.West	2	5	2	9
Dictyosphaerium ehrenbergianum Näg.	1	4		5
Dictyosphaerium pulchellum Wood.	5	5	2	12
Didimocystis planctonica Kors.	7			7
Monoraphidium contortum (Thur.) Kom.-Legn.	9	9	12	30
Monoraphidium griffithii (Berk.) Kom.-Legn.	3	7	3	13
Monoraphidium minutum (Näg.) Kom.-Legn.	3	3	4	10
Monoraphidium mirabile (W.&G.S.West) Kom.-Le	3	3	7	13
Neodesmus danubialis Hind.	1	3		4
Oocystis borgei Snow	5		1	6
Pediastrum boryanum (Turp.) Menegh.	1	2	1	4
Pediastrum duplex Meyen		3	1	4
Scenedesmus acuminatus (Lagerh.) Chod.	1	11	12	24
Scenedesmus acutus Meyen	2	1	5	8
Scenedesmus bicaudatus Dedus.			4	4
Scenedesmus ecornis (Ehr.) Chod.	4	10	12	26
Scenedesmus opoliensis P.Richt.			10	10
Scenedesmus quadricauda (Turp.) Bréb.	7	10	17	34
Scenedesmus spinosus Chod.	2	1	6	9
Schroederia setigera (Schröd.) Lemm.	3	6		9
Stigeoclonium tenue Kütz.	18	7	7	32
Tetraedron caudatum (Corda) Hansg.	1	4	2	7
Tetrastrum glabrum (Roll) Ahlstr.&Tiff.	4	1	3	8
Ulothrix zonata Küttz.	5			5
Uronema elongatum Hodg.	6			6

Diversity

The diversity and its maximum follow the decrease of number of taxa at CBS. Fig. 8. shows the changes of diversity at sampling point c5. Both values are decreased here. This phenomenon can be observed at every sampling points at CBS which is the most disturbed area.

By contrast, Fig. 8. presents the same values at the almost undisturbed part of ÁBS. Though the diversity in undisturbed area no decrease, we suppose, that the changes at CBS caused by the diversion of Danube, and connected work impact and no other influences in the concerned part of Szigetköz caused the decrease of diversity instead of other changes (e.g. the influence of weather or amount of discharge).

Summary

To follow the long term changes in Szigetköz, the samples collected in 1991 and in 1992 constitute a status survey, and they were compared to samples collected in 1995. 8 sampling points chosen in the branch systems called Cikolasziget and Ásványráró, respectively. The quantity of periphyton increased in every sampling points (bentonic eutrophication!) while the number of taxa and the diversity decreased. In the more disturbed branch system (Cikolasziget) more changes were observed than in the moderately disturbed Ásványráró branch system.

Acknowledgement

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Authors' adress:

Dr. Krisztina Buczkó
Botanical Department of the
Hungarian Natural History Museum
Budapest P.O.Box 222
H-1476
Hungary

Dr. Éva Ács
Microbiological Facultate of the
Eötvös Loránd University
Budapest Múzeum krt. 4/a
H-1088
Hungary