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Silica-scaled chrysophytes from Hungary

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Introduction

The silica-scaled chrysophyte flora of Hungary has been poorly documented. Although many data were published during the 20th century, little was actually validated because of the lack of electron microscopical studies (KRISTIANSEN & PADISÁK 1992). There are some records from summer samples collected in the Kis-Balaton reservoir (KRISTIANSEN & PADISÁK 1992) and sporadic data from rivers and shallow lakes (KISS 1987, ÁCS & KISS 1991, KISS & KRISTIANSEN, 1994). Based on the above-cited papers, the occurrence of three species of Chrysophyceae and seven species of Synurophyceae was reported. In 1995, a detailed survey was begun to explore silica-scaled chrysophyte flora in Hungary. Despite the sampling of almost 200 localities, only two localities supported interesting and rich silica-scaled flagellate floras – a temporary ditch in Hortobágy, Eastern Hungary (PÉTERFI et al. 1998a) and Lake Baláta, a protected bog lake in SW Hungary (PÉTERFI et al. 1998b). The aim of this paper is to show some unpublished data from backwaters of large rivers and shallow, eutrophic water bodies and to summarize the results of the 4-year survey.

Material and methods

Samples were collected during the summer of 1995 and the spring of 1996 from approximately 160 localities in Hungary using either a plankton net (mesh size 10 µm) or large-volume plastic bottles for off-shore samples. The material was then concentrated on membrane filters (Pragopor, 3 µm). The samples were investigated first by light microscopy in dry preparates for the presence/absence of silica-scaled flagellates. Positive samples were then subjected to electron microscope (EM) investigations. They were preserved in 4% formaldehyde solution. Drops of the material previously rinsed with distilled water were placed on formvar- or parlodion-coated grids by means of a pipette. In some cases the material was treated with concentrated nitric acid and then repeatedly washed with distilled water in order to remove the acid and other soluble remnants. After drying, the grids were examined under a TESLA BS-500 transmission electron microscope at the Babes-Bolyai University, Kolozsvár, Romania.

This paper describes silica-scaled flagellate flora from ten localities (Fig. 1). The following list describes the locality and, in parentheses, date of sampling, and if known, water temperature, pH and conductivity.

1. Szeremlei holtág, a sluice on backwater of the R. Danube at Baja city (20 April 1996, 14.5 °C, 7.9, 372 µS cm^{-1})
2. Szeremlei holtág, a sluice on backwater of the R. Danube at Szeremle village (13 February 1996, 7.5 °C, 8.25, 310 µS cm^{-1})
3. Cserlei holtág, a sluice on backwater of the R. Danube at Baja city (13 February 1996, 7.5 °C, 7.75, 398 µS cm^{-1})
4. Kék tó, a small lake in Baja city (20 February 1996, 6.8 °C, 8.0, 570 µS cm^{-1})
5. Backwater of the R. Danube at Győr city (8 August 1995, >25 °C, 7.0)
6. Tőserdei holtág, backwater of the R. Tisza in Lakitelek village (24 August 1995)
7. Kis-Balaton Reservoir (10 August 1996, 27–29 °C; 8.2)
8. Fishpond at village Hegyesd (26 August 1996, >25 °C)
9. Fishpond at village Köröshegy (26 August 1996, >25 °C)
10. Fishpond at village Irmapuszta (27 August 1996, >25 °C)

Results and discussion

The present findings show the occurrence of 20 silica-scaled chrysophytes in ten localities, mostly fishponds and river backwaters, distributed in western Hungary. Though these chrysophytes have been previously recorded in Hungary, the EM records complete their distribution trends in the Carpathian Basin. EM investigations recorded 38 silica-scaled chrysophyte species in Hungarian waters (Table 1) and their distribution among the genera are as follows: *Chrysosphaerella* 2, *Mallomonas* 27,

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Paraphysomonas 1, *Spiniferomonas* 1 and *Synura* 7.

Most of the species are widely distributed and occur all year round (WEE 1981, ASMUND & KRISTIANSEN 1986, KRISTIANSEN 1988, SIVER 1991, KRISTIANSEN & VIGNA 1996). Species with special distribution patterns are rather rare (PÉTERFI & MOMEU 1996, PÉTERFI et al. 1998a, 1998b), and the presence of *Mallomonas cyathellata* and *M. portae-ferreae* is quite remarkable. They occur most frequently in tropical and subtropical regions, Hungary forming part of the northern boundary of their area.

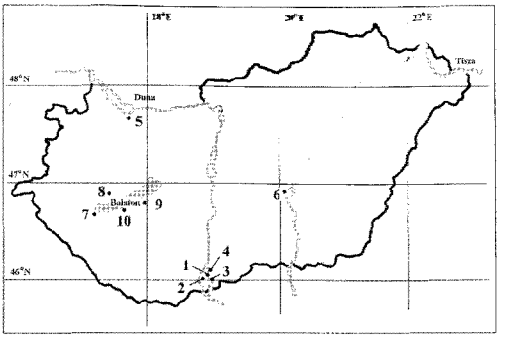

Fig. 1. Distribution of localities searched for silica-scaled chrysophytes in Hungary, as listed in Material and methods of this paper.

Table 1. Occurrences of different silica-scaled flagellate species in Hungary. Columns numbered from 1 to 10 are localities as indicated in Material and methods. Subsequent columns contain data described in (a) KRISTIANSEN & PADISÁK (1992), (b) Kiss (1987), ÁCS & KISS (1991), KISS & KRISTIANSEN (1994), (c) PÉTERFI et al. (1998a) and (d) PÉTERFI et al. (1998b).

Species	Localities													
	1	2	3	4	5	6	7	8	9	10	a	b	c	d
Chrysosphaerella annulata Kristiansen et Tong							+				+			
C. brevispina Korshikov	+												+	+
Paraphysomonas vestita (Stokes) De Saedeleer			+		+	+	+	+	+		+		+	
Mallomonas acaroides Perty em. Ivanov		+			+			+	+	+	+	+	+	+
M. akrokomos Ruttner in Pascher											+		+	+
M. alata Asmund, Cronberg et Dürrschmidt														+
M. alpina Pascher et Ruttner in Pascher		+	+			+	+	+	+	+	+	+	+	
M. annulata (Bradley) Harris	+												+	+
M. areolata Nygaard													+	+
M. calceolus Bradley													+	+
M. caudata Ivanov em. Krieger			+		+	+		+			+	+	+	+
M. clavus Bradley														+
M. corymbosa Asmund et Hilliard						+							+	
M. crassisquama (Asmund) Fott													+	+
M. cyathellata Wujek et Asmund						+				+			+	
M. elongata Reverdin										+			+	
M. heterospina Lund													+	+
M. insignis Penard														+
M. intermedia Kisselev em. Péterfi et Momeu													+	
M. mangofera Harris et Bradley														+
M oviformis Nygaard														+
M. papillosa Harris et Bradley														+
M. paxillata (Bradley) Péterfi et Momeu													+	
M. pillula Harris														+
M. portae-ferreae Péterfi et Asmund					+			+					+	
M. punctifera Korshikov	+												+	+
M. scalaris Dürrschmidt														+
M. teilingii Conrad	+										+		+	+
M. tonsurata Teiling			+		+	+	+	+			+	+	+	
M. transsylvanica Péterfi et Momeu														+
Spiniferomonas trioralis Takahashi					+			+			+			
Synura curtispina (Petersen et Hansen) Asmund			+	+					+		+	+	+	+
S. echinulata Korshikov				+					+			+		+
S. multidentata (Balonov et Kuzmin) Péterfi et Momeu														+
S. petersenii Korshikov	+	+	+					+	+		+	+	+	+
S. spinosa Korshikov													+	+
S. splendida Korshikov													+	
S. uvella Ehrenberg em. Stein		+											+	+

Many of the species are preferentially eutrophic and such habitats are extensively found in Hungary (large rivers, river backwaters, fishponds, reed swamps or other shallow waters). The most characteristic *Mallomonas* species in summer phytoplankton of eutrophic shallow lakes and large river backwaters in Hungary are shown in Fig. 2.

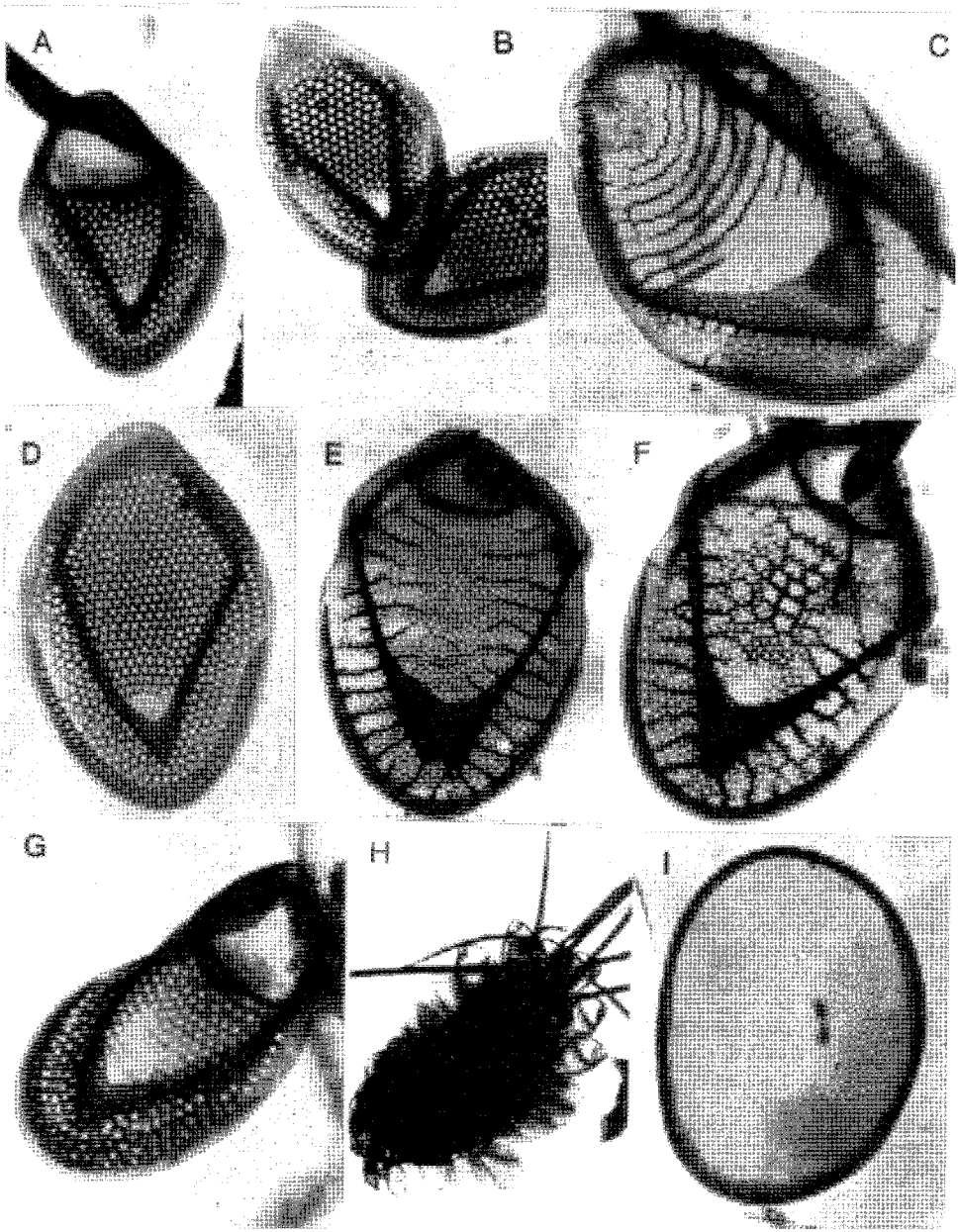

Fig. 2. The most characteristic *Mallomonas* species in summer phytoplankton of eutrophic shallow lakes and large river backwaters in Hungary. A, B: *M. tonsurata,* apical (A) and domeless body (B) scales. C: *M. portae ferreae,* domeless body scale. D, G: *M. cyathellata,* domeless body (D) and bristle-bearing apical (G) scales. E F: *M. acaroides,* bristle-bearing body scales with typical (E) and reticulate (F) shield structures. H: *M. alpina* whole cell armour. I: *M. caudata,* body scale. A–D, F, G: ×10,000; E: ×8,000; H: ×2,500; I: ×6,000.

Species with special ecological preferences (lower mineral content, acidity, etc.) are apparently less well distributed in Hungary, because such habitats are scarce and most of those that are there have not yet been investigated. There are only two exceptions: a small temporary bog in the Hortobágy and the bog-lake Baláta-tó, a nature reserve. One should note the occurrence in these habitats of *Mallomonas annulata, M. calceolus, M. clavus, M. heterospina, M. intermedia, M. transsylvanica, Synura splendida,* etc. They are probably not so rare in Hungary, but have not yet been detected as other possible localities have not been sampled. Other species such as *Mallomonas alata, M. pillula* and *M. scalaris* are rare indeed, with few records from anywhere in the world.

From the 4-year investigation it became evident that the most extended water bodies of Hungary (standing or slightly flowing, natural or artificial) are inhabited by a characteristic group of silica-scaled chrysophytes. They are preferentially eutrophic, their occurrence is not restricted to a particular season and not all are necessarily present at the same time and with high population densities. To this group belong *Paraphysomonas vestita, Mallomonas acaroides, M. akrokomos, M. alpina, M. areolata, M. caudata, M. crassisquama, M. punctifera, M. teilingii, M. tonsurata, Spiniferomonas trioralis, Synura curtispina, S. petersenii* (incl. vars.) and *S. uvella.* During summer *Mallomonas cyathellata, M. portae-ferreae* and *Synura echinulata* may join the usual silica-scaled chrysophyte group.

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