Floristic notes on plankton algae of Norris Lake (Tennessee, USA)

Floristické nálezy planktonních řas údolní přehrady Norris Lake (Tennessee, USA)

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Kalina T., Walne P. L. & Houk V. (2001): Floristic notes on plankton algae of Norris Lake (Tennessee, USA). – Preslia, Praha, 73: 121–126.

Centric diatoms, silica-scaled chrysophytes and a desmid, *Gonatozygon monotaenium*, are the dominant components of the plankton algal community developed in autumn, 1998, in the Norris Lake (Tennessee, USA). This is the first and preliminary contribution to the Norris Lake phytoplankton.

Keywords: Phytoplankton, centric diatoms, desmid, Norris Lake, Tennessee, USA

Basic information about the Norris Lake

Norris Lake is located about 30 miles north-west from Knoxville, Tennesee. It was created in 1936 by the damming of the Clinch River, one of the main tributaries of the Tennessee River, on the border of two counties, Union and Campbell. As a project of Tennessee Valley Authority it serves both as a water reservoir and for recreational activities. The surface area varies between summer and winter as it is intentionally drained in winter to provide room for spring floods or rains. At the time of sample collecting (9 November 1998) the water level was low, about 2 m below the highest watermark reaching gradually its winter pool, which is about 6.03 km^2. The water was colourless, with a very low density of plankton. The properties of the samples collected in Norris Lake Marina, were as follows: surface water temperature 20° C, pH 7.3; conductivity 220 $\mu S \cdot cm^{-1}$. The conductivity value corresponds to a moderate content of soluble solids.

Only 15 dominant species were found in plankton. Among them the centric diatoms occupy the leading position: *Aulacoseira ambigua, A. granulata, Cyclotella bodanica* var. *affinis, Stephanodiscus niagarae*. The diatoms were associated with dinophytes [*Ceratium hirundinella* (O. F. Müller) Dujardin], and chrysophytes (*Dinobryon divergens*, five *Mallomonas* species, two *Synura* species). *Gonatozygon monotaenium* (*Desmidiales*) was found as an unusual component of the plankton.

Some species are characteristic components of North American lake phytoplankton (*Stephanodiscus niagareae* Ehrenberg, *Mallomonas pseudocoronata* Prescott and with some probability also the desmid *Gonatozygon monotaenium*). This article is the first report of the Norris Lake phytoplankton.

Material and methods

One set of plankton samples was collected by plankton net (30 μm mesh size) from the pier of the marina. Two living samples containing about 100 ml of the lake water were observed in laboratory, and then fixed with the acidified Lugol solution. The diatom frustules and scales of the chrysophytes were prepared as described in the previous paper (Kalina et al. 2000). The LM micrographs were made using Zeiss JENAVAL contrast microscope. The electron micrographs were made with TEM Philips 300. The LM as well as TEM pictures were prepared using digital processing and printing with an image processing program.

Remarks on individual species

Synurophyceae

Mallomonas alpina Asmund et Kristiansen (Fig.1a)

Alkalibiontic species, growing in meso-eutrophic waters with pH 8.0, sometimes reported in conditions below pH 6.5 (Siver, 1989). Widely distributed, common, but only scales were found in Norris Lake.

Mallomonas caudata Ivanov et Krieger (Fig. 1b)

Most abundant species among the other chrysophytes found in the Norris Lake. Individual living cells are about 60 μm long and 45 μm broad. The scales, easily visible in LM, are about 3 μm × 2.5 μm. The spines are up to 100 μm long. The TEM micrograph shows the prominent granulation on the scale surface. The species is pH indifferent, common in eutrophic as well as in oligotrophic waters (Siver 1989, 1996).

Mallomonas pseudocoronata Prescott (Fig. 1c)

This species was reported from numerous sites in Canada, (Asmund & Kristiansen 1986), Florida, USA (Wujek 1984), and Panama (Wujek 1987). Common in alkaline lakes. Some scales were found without the anterior wings.

Mallomonas ouradion Harris et Bradley (Fig. 1d)

Acidophilic-oligotrophic species (pH < 5) whose ability to survive shifts from pH 3.30 to 4.35 (Kalina 1969, Kalina et al. 2000). Distributed but scattered species (Asmund & Kristiansen 1986, Nicholls 1988). Its occurrence in the moderate alkaline lake is rather unusual and can be explained by very low concentration of soluble solids.

Synura echinulata (Korshikov) Korshikov (Fig. 1e)

This species is scattered in Norris Lake, where only one scale was found. It inhabits oligo- as well as eutrophic waters. It is a pH indifferent species in the range of pH 5.5–7.0 (– 9.0) (Siver 1989).

Synura sphagnicola Korshikov (Fig. 1f)

The species was very rare in Norris Lake, where only one scale was recorded. It is considered as an acidobiontic species, which is more common in humic waters, and common in waters with pH < 5.5. Its occurrence diminished rapidly above pH 6.0 (Siver 1989).

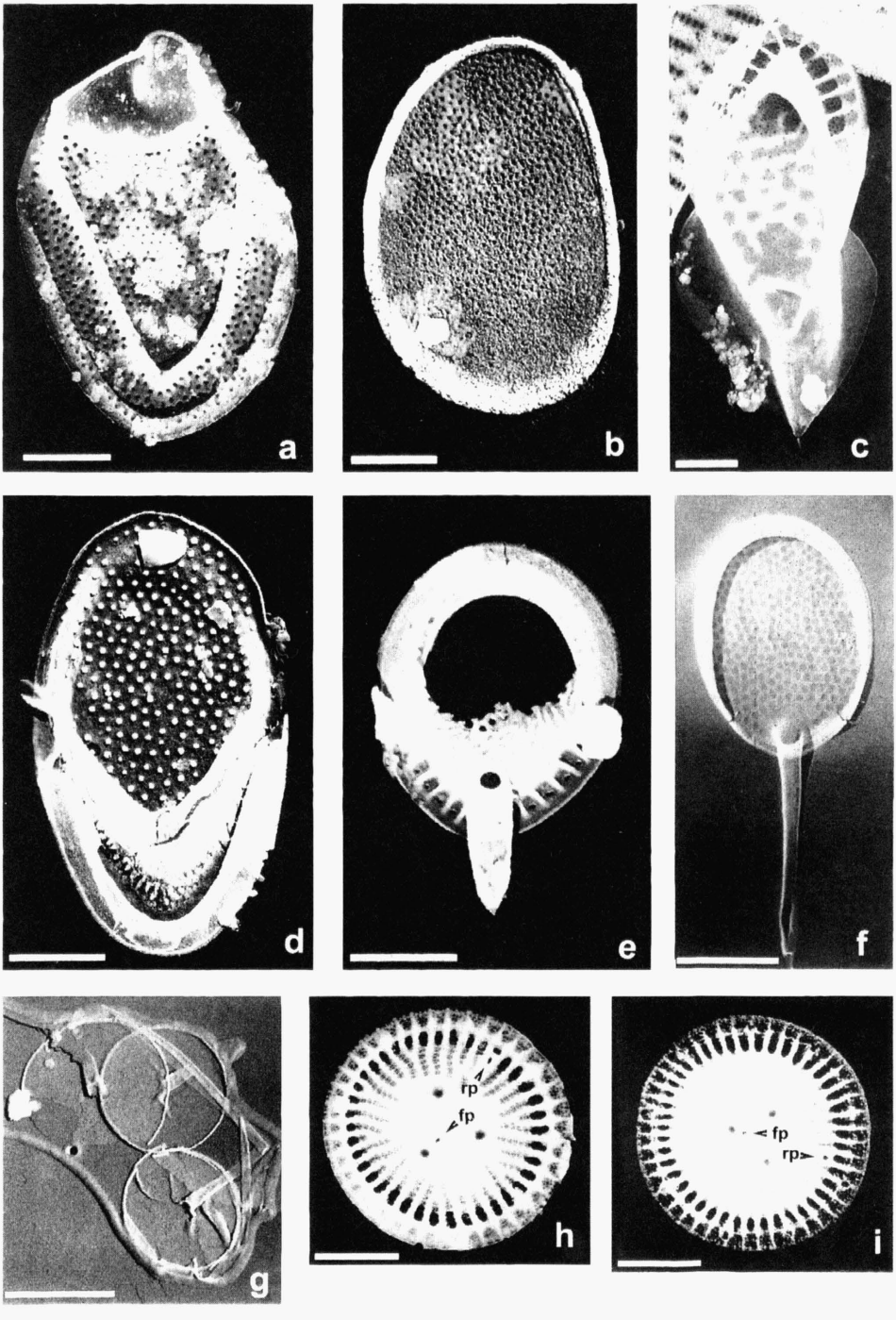

Fig. 1. – Silica-scaled chrysophytes and centric diatoms in the Norris Lake (Tennessee, USA). (a) *Mallomonas alpina*; (b) *Mallomonas caudata*; (c) *M. pseudocoronata*; (d) *M. ouradion*; (e) *Synura echinulata*; (f) *Synura sphagnicola*; (g) *Paraphysomonas vestita*, a group of the scales with the broken spines (TEM, bar = 1 μm); (h), (i) *Cyclotella* aff. *ocellata*, two valve faces. See one central fultoportula (fp) and a rimoportula (rp). (TEM, bar = 2 μm).

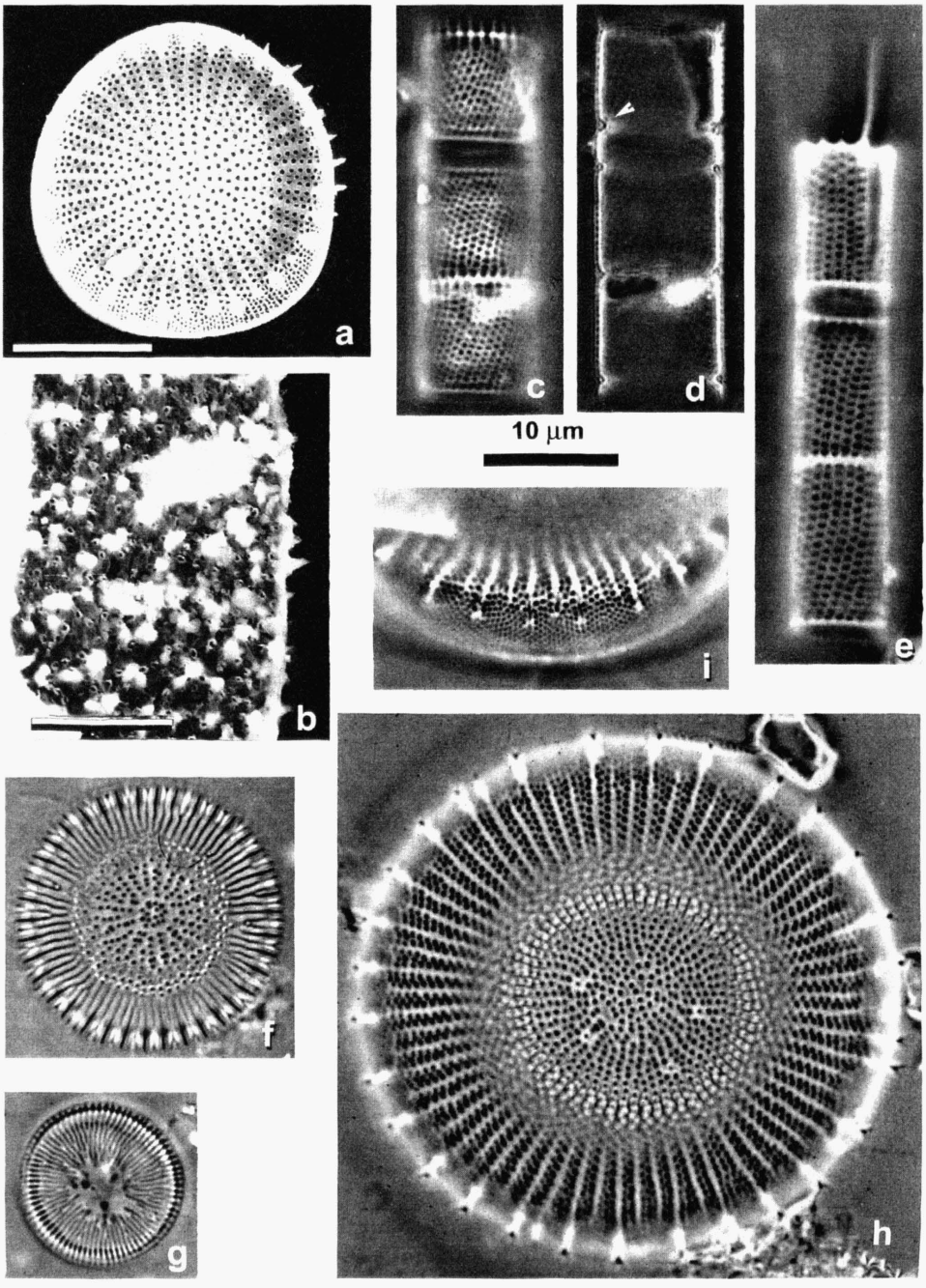

Fig. 2. – Diatoms and a desmid in the Norris Lake (Tennessee, USA). (a) *Stephanodiscus niagarae*, a valve with a marginal ring of spines (TEM, bar = 5 µm); (b) *Gonatozygon monotaenium* var. *monotaenium*, part of the empty cell wall, shadow cast with chromium (TEM, bar = 1 µm); (c), (d) *Aulacoseira ambigua*: two foci of a girdle view; c: focused to the valve surface. See the upper valve with dividing spines; d: focused to the medial section of the frustules. See the typical shape of sulci (arrowhead); (e) *Aulacoseira granulata*: a girdle view. See two valve pattern types; (f) *Cyclotella bodanica* var. *affinis*, a valvar view. See forked costae at the valve margin; (g) *Cyclotella* aff. *ocellata*: a valvar view; (h), (i) *Stephanodiscus niagarae*, valvar views; h: See the distinct central fultoportulae; i: a tilted valve. See relatively high valve mantle with a regular pattern of areolae (LM, bar = 10 µm).

Chrysophyceae

Dinobryon divergens Imhof

Abundant species, circumneutral and mesotrophic, common in the area.

Paraphysomonas vestita (Stokes) De Saedler (Fig. 1g)

Circular scales with a long, gradually tapered spine. The spines in Fig. 1g are broken. Most frequently recorded species of the genus, which is distributed in various freshwaters, but is relatively rare in Norris Lake.

Bacillariophyceae

Aulacoseira ambigua (Grunow) Simonsen (Fig. 2 c, d)

Cosmopolitan plankton species, often abundant in eutrophic rivers, reservoirs and lakes. The most frequent taxon in Norris Lake.

A. granulata (Ehrenberg) Simonsen (Fig. 2e)

A cosmopolitan plankton species, often abundant in eutrophic rivers, reservoirs and lakes. Its occurrence in Norris Lake contradicts to the low content of soluble minerals. The conductivity between 200–400 mS is more usual for this species.

Cyclotella bodanica var. *affinis* (Grunow) Cleve-Euler (Fig. 2f)

Rare in the Norris Lake.

Cyclotella aff. *ocellata* Pantocsek (Fig. 1 h, i; Fig. 2g)

Cosmopolitan species, in the littoral of lakes, reservoirs or ponds with sand or gravel ground. Rare in the Norris Lake.

Rhizosolenia cf. *longiseta* Zacharias

The whole living cells are up to 100 mm high, with apical spines about 52 mm long, diameter of the frustules is 9.5 mm. Often recorded in Norris Lake. Cosmopolitan species with scattered occurrence in eutrophic lakes.

Stephanodiscus niagarae Ehrenberg (Fig. 2 a, h, i)

This species is, together with *Aulacoseira ambigua*, the dominant centric diatom in Norris Lake. Stoermer & Yang (1970) recorded the species in naturally eutrophic areas favouring moderate nutrient enrichment. Krammer & Lange-Bertalot (1991) described var. *magnifica* as the characteristic taxon of North-American lakes. The species inhabits mesotrophic and also hyper-eutrophic waters. Julius et al. (1998) established the extirpation of this species in Lake Ontario, explained by heavy industrial pollution.

Conjugatophyceae: Desmidiales

Gonatozygon monotaenium Rabenhorst var. *monotaenium* (Fig. 2b)

Cells cylindrical, sometimes curved, the apices truncate and slightly dilated. Up to 10 × longer than broad, forming short chains of 4–8 cells. Chloroplasts axial (two in each cell), undulate, containing 3–4 pyrenoids. Cell wall minutely and densely granular, almost invisible in the light microscope. Fine structure of the cell wall consists of electron-opaque granules and minute pores (Fig. 2b). The species represents the prominent component of the Norris Lake plankton. The variety is widely distributed in soft-water bogs and lakes (Prescott et al., 1972).

Acknowledgements

The authors express their thanks to Raymond W. Holton (Department of Botany, University of Tennessee) and Clifford C. Amundsen (Department of Ecology & Evolutionary Biology) for additions to the text, critical reading of the manuscript and language correction. The research was supported from the Grant Agency of the Czech Republic, grant no. 206/98/1193. The authors acknowledge support of the Hesler Visiting Professor Award to T. K.

Souhrn

Centrické rozsivky, chrysomonády s křemitými šupinkami a krásivka *Gonatozygon monotaenium* jsou dominantní druhy planktonu jezera Norris Lake (Tennesee, USA), pozorovaného na podzim v roce 1998. Toto je první předběžný příspěvek k poznání fytoplanktonu jezera Norris.

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Received 15 June 2000
Accepted 13 October 2000