Five species of *Mallomonas* (*Synurophyceae*) new to the algal flora of the Czech Republic

Pět druhů chrysomonád rodu *Mallomonas* (*Synurophyceae*) nových pro algoflóru České republiky

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Řezáčová M., Neustupa J. & Šejnohová L. (2004): Five species of *Mallomonas* (*Synurophyceae*) new to the algal flora of the Czech Republic. – Preslia, Praha, 76: 175–181.

Five new records of the scale-bearing chrysophytes *Mallomonas multiunca, M. paxillata, M. portae-ferreae, M. prora* and *M. retifera* are reported for the Czech Republic. *M. multiunca* was found in a mesotrophic oxbow lake of the river Vltava. *M. paxillata, M. portae-ferreae* and *M. prora* were found in a mesotrophic to eutrophic floodplain pool of the river Lužnice. *M. retifera* was recorded from alluvial pools associated with the Vltava and Lužnice rivers, respectively. Autecology and distribution of the species are discussed. Three of the species occur in temperate and subarctic regions, *M. paxillata* probably has a cosmopolitan distribution and *M. portae-ferreae* prefers warmer water, occurring most frequently in tropical to subtropical regions.

Keywords: autecology, Czech Republic, distribution, Lužnice, *Mallomonas, Synurophyceae*, Vltava

Introduction

Several papers have been published on the silica-scaled chrysophytes in the Czech Republic (Kalina et al. 2000, Němcová et al. 2001, Neustupa et al. 2001, Němcová et al. 2002) but knowledge of the species composition is still far from complete. The present paper reports five additional species, which were recorded from the floodplain pools and oxbow lakes of the rivers Vltava and Lužnice during a long-term systematic research study. In terms of the occurrence of silica-scaled chrysophytes these localities are very rich. Both areas are among the last alluvial refuges in Central Europe.

Localities studied

Both the localities investigated are alluvial pools in the floodplains of Lužnice and Vltava in S Bohemia, Czech Republic (Fig. 1):

1. The system of alluvial mesotrophic pools and oxbow lakes on upper Vltava occur at 48°55' N 13°55' E and at the altitude of 730 m a.s.l. The species were recorded in two oxbow lakes designated as A and B (Šejnohová 2003), which are situated in the core zone Vltavský luh of the Šumava National Park. The chrysophyte flora of this area was investigated first by Němcová et al. (2002). The research on algal biodiversity was carried out by Šejnohová (2003).

2. The T2 pool is located in the alluvial deposits of the upper Lužnice. This pool was designated because its planktonic algal flora was known in some detail (Pithart et al. 1996,

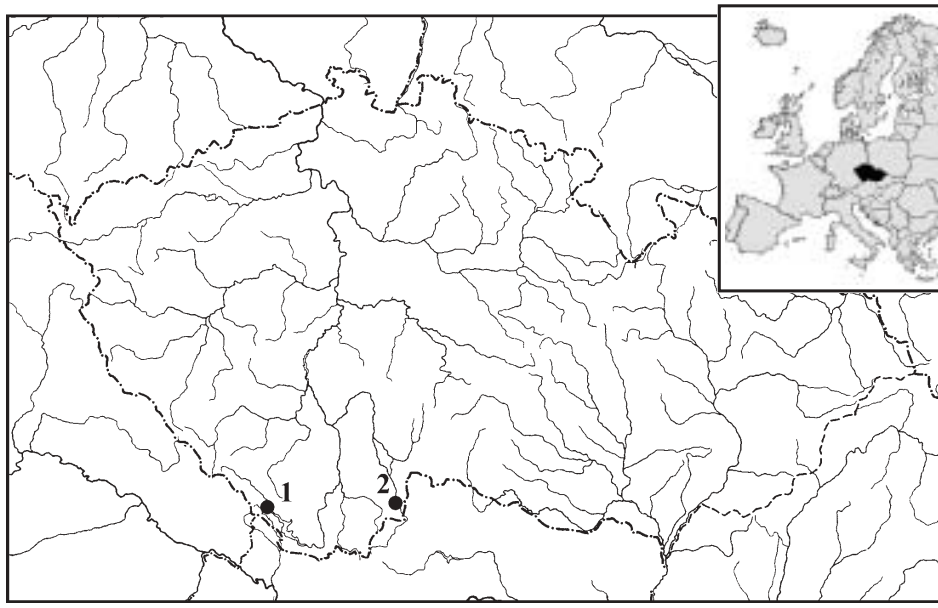

Fig 1. – Map of the Czech Republic, showing the location of the sampling areas.

Pithart 1997, Kylbergerová et al. 2002, Němcová et al. 2002). Several times a year the river floods the whole locality. The T2 pool (48°50' N 14°55'40" E) is a mesotrophic to eutrophic water body at an altitude of 460 m a.s.l.

Throughout the year, flagellates prevail in the phytoplankton of all of three localities, even though their abundance and composition are not constant. Cryptophytes, euglenophytes and silica-scaled chrysophytes dominate mainly in the colder periods of the year. During summer, they occur together with coccal and monadoid green algae or with cyanophytes but contribute little to the total biomass of phytoplankton.

Environmental parameters and the dates on which the samples were collected are summarized in Table 1. The species of silica-scaled chrysophytes recorded on particular dates are presented in Table 2.

Methods

The samples were collected using a 40 μm mesh plankton net and as total water samples. Water temperature, pH and conductivity were measured in the field using a WTW Multiline set with field probes. Both fresh and Lugol fixed phytoplankton samples were examined under a light microscope. Preparation of both the plankton net and total water samples for transmission electron microscopy included treatment with hydrogen peroxide and potassium dichromate, which removed part of the redundant organic material. Purified samples were rinsed in distilled water in a centrifuge, dried on to Formvar coated copper grids and shadowcast with chromium. The grids were examined using a Philips T 300 transmission electron microscope.

Results and discussion

Mallomonas multiunca Asmund (Fig. 2A)

Scales of this species were found only in oxbow lake B. Scales of *M. multiunca* have broad domes with a series of parallel ribs. The longitudinal apical rib fuses with the submarginal rib just below the proximal border of the dome forming two distinct meshes. *M. multiunca* occurs in temperate, arctic and subarctic ecosystems in the Northern hemisphere (Kristiansen 2002). Takahashi (1978) designated this species as alkalibiontic. However, Siver (1991) after a more comprehensive investigation characterized *M. multiunca* as typical mostly of biotopes with a low pH, which accords with our finding. Asmund (1959) reported its adaptability to different environmental factors.

Mallomonas paxillata (Bradley) Péterfi et Momeu (Fig. 2B)

Many scales of this species were found in pool T2. The base plate of the scales of *M. paxillata* lacks pores. On some anterior scales one anterior submarginal rib runs along the lateral side of the dome and projects forward forming a rather sharp spike (Siver 1991). *M. paxillata* is distributed worldwide, but rarely abundant, as only a few scales were found (Dürrschmidt 1984, Péterfi et al. 1998). Its designation as a cold-water species agrees with our finding (Hartmann & Steinberg 1989). This species probably has a bipolar distribution in the temperate zones and a scattered occurrence in subtropical regions (Kristiansen 2002).

Mallomonas portae-ferreae Péterfi et Asmund var. *portae-ferreae* (Fig. 2C)

A few body scales were found in October in pool T2. The shield of the scales has up to ten transverse slightly curved ribs, which are occasionally interconnected by cross ribs.

The species prefers neutral to alkaline biotopes (Siver 1991). *M. portae-ferreae* is repeatedly reported from warm waters, especially eutrophic tropical lakes with high conductivity (Compère 1973, Saha & Wujek 1990, Vyvermann & Cronberg 1993). Further, Péterfi & Momeu (1996) found this species in summer plankton in warm temperate lakes in Romania. Siver (1991) records it occurring in the temperature range 2–28 °C sporadically throughout the year.

Mallomonas prora Dürrschmidt (Fig. 2D)

A few specimens of this species were observed sparsely in April 2002 in pool T2. Some of its body scales are strongly asymmetrical. Irregularly arranged patches and stripes of particularly electron-dense material create an additional pattern on the shield (Kristiansen 2002). *M. prora* has only been reported a few times from water bodies in temperate regions. So far, *M. prora* is reported from the Netherlands, N Germany, Finland, S USA, Chile and Japan (for references see Kristiansen 2002). A bipolar distribution is assumed for this rare organism (Kristiansen 2002). At present there is little data on its environmen-

Table 1. – *Mallomonas* species recorded and environmental features of the investigated localities.

Species	Locality	Sampling date	Water temperature (°C)	pH	Conductivity µS/cm
M. multiunca	oxbow lake B	25. 6. 2002	18.0	6.0	63
M. paxillata	T2 pool	11. 4. 2002	5.5	6.7	208
M. portae-ferreae	T2 pool	11. 10. 2002	7.8	6.7	192
M. prora	T2 pool	11. 4. 2002	5.5	6.7	208
M. retifera	oxbow lake A	25. 6. 2002	18.8	5.2	62
M. retifera	T2 pool	10. 9. 2002	16.4	6.4	199

Table 2. – The silica-scaled chrysophytes present at two localities on particular dates.

Species	T2 pool 11. 4. 2002	T2 pool 10. 9. 2002	T2 pool 11. 10. 2002	Oxbow lake A 25. 6. 2002	Oxbow lake B 25. 6. 2002
Mallomonas acaroides Perty em. Ivanov		+	+		
M. actinoloma Takahashi var. *maramuresensis* Péterfi et Momeu	+				
M. akrokomos Ruttner in Pascher	+	+			
M. alata Asmund et al. f. *alata*	+	+			
M. alpina Pascher et Ruttner in Pascher em. Asmund et Kristiansen	+				
M. annulata (Bradley) Harris	+	+			
M. calceolus Bradley	+				
M. caudata Ivanov em. Krieger			+	+	+
M. costata Dürrschmidt					+
M. crassisquama (Asmund) Fott	+				
M. doignonii Bourrelly em. Asmund et Cronberg var. *doignonii*	+				
M. heterospina Lund	+	+			
M. intermedia Kisselev em. Péterfi et Momeu var. *intermedia*		+		+	+
M. multiunca Asmund					+
M. papillosa Harris et Bradley var. *papillosa*	+				
M. paxillata (Bradley) Péterfi et Momeu	+				
M. portae-ferreae Péterfi et Asmund var. *portae-ferreae*			+		
M. prora Dürrschmidt	+				
M. pumilio Harris et Bradley em. Asmund et al. var. *pumilio*		+			
M. punctifera Korshikov var. *punctifera*		+			+
M. retifera Dürrschmidt		+		+	
M. schwemmlei Glenk em. Glenk et Fott	+	+			
M. striata Asmund var. *striata*	+	+			
M. tonsurata Teiling em. Krieger var. *tonsurata*		+			
Synura curtispina (Petersen et Hansen) Asmund		+			
S. echinulata Korshikov	+	+	+		
S. petersenii Korshikov f. *petersenii*	+	+	+	+	+
S. spinosa Korshikov f. *spinosa*	+	+		+	
S. uvella Ehrenberg	+				
Spiniferomonas sp.		+	+		

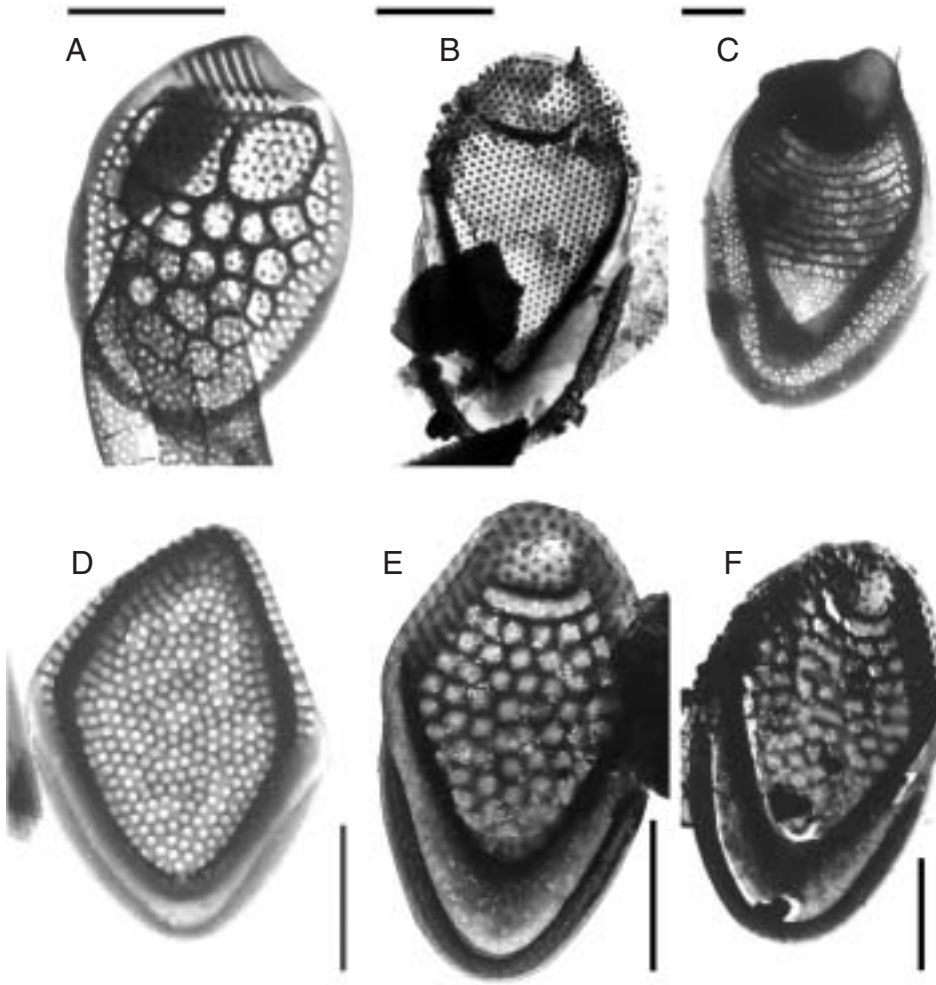

Fig. 2. – A. *Mallomonas multiunca*, body scale; B. *Mallomonas paxillata*, apical scale; C. *Mallomonas portae-ferreae* var. *portae-ferreae*, body scale; D. *Mallomonas prora*, body scale; E, F. *Mallomonas retifera*, body scales. Scale bar 1 μm.

tal preferences. Dürrschmidt (1982 b) and Roijackers (1986) recorded this species from water with a pH range of 6.3–8 and conductivity of 20–370 μS/cm, which confirms with our observations.

Mallomonas retifera Dürrschmidt (Fig. 2E, F)

The scales of *M. retifera* were plentiful at both localities (oxbow lake A and T2 pool). Anteriorly on the shield of the body scales there are two well defined transverse ribs. The other ribs are interconnected in such a way that they form a reticulum with roughly rectangular meshes (Kristiansen 2002).

This rare species is reported several times from temperate water bodies in both hemispheres, in particular in Romania, Germany, Chile and Japan (for references see Kristiansen 2002). Dürrschmidt (1982a) and Hartmann & Steinberg (1989) record it at lower temperatures (2–8 °C). However, we found the species at 16.4 °C and 18.8 °C.

Conclusions

The system of pools and oxbow lakes in the alluvial plains of upper Vltava and Lužnice is considered one of the most valuable sites for phytoplankton biodiversity in central Europe (Pithart 1999, Šejnohová 2003). The occurrence there of five additional species of silica-scaled chrysophytes further emphasizes their importance for the preservation of algal biodiversity in central Europe. *Mallomonas multiunca*, *M. paxillata* and *M. portae-ferreae* have repeatedly been found in central Europe and therefore their occurrence in all these localities is not surprising. However, *Mallomonas prora* and *M. retifera* are rare species, and both their autecology and distribution are poorly known. The frequent occurrence of *M. retifera* in the alluvial areas of Lužnice is an important contribution to the knowledge of the autecology of this species.

Acknowledgements

We are indebted to Tomáš Kalina, Yvonne Němcová, David Pithart, Daniel Fiala and Pavel Škaloud for technical support and valuable comments. Tony Dixon kindly improved our English. The study was funded by the Czech Ministry of Education research project no. J13/98113100004 and by grant no. 206/01/1113 from the Grant Agency of the Czech Republic.

Souhrn

Pro Českou republiku bylo zaznamenáno pět nových druhů rodu *Mallomonas*, který náleží mezi chrysomonády se schopností vytvářet křemité šupiny. *M. multiunca* byl nalezen v mesotrofním slepém rameni v nivě řeky Vltavy. Druhy *M. paxillata*, *M. portae-ferreae* a *M. prora* byly objeveny v mesotrofní až eutrofní tůni v nivě řeky Lužnice, *M. retifera* byl zaznamenán ve dvou vodních tělesech řeky Vltavy i Lužnice. U všech druhů jsou uvedeny dosavadní poznatky o jejich ekologii a rozšíření. Tři ze zkoumaných druhů se vyskytují v mírném a subarktickém pásmu, *M. paxillata* je pravděpodobně rozšířen kosmopolitně a *M. portae-ferreae* upřednostňuje teplé vody. Centrem jeho výskytu jsou tropické a subtropické oblasti.

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Received 19 November 2003
Revision received 5 April 2004
Accepted 10 April 2004