

***Mallomonas kalinae* (Synurophyceae), a new species of alga from northern Bohemia, Czech Republic**

Mallomonas kalinae, nový druh řasy ze třídy Synurophyceae ze severních Čech

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A new species of *Mallomonas*, *M. kalinae*, is described from a small peaty pool Ostrov in the Bohemian Switzerland National Park (northern Bohemia). The species is located in the section *Papillosae* and its morphological characteristics are closest to *M. rasilis*, *M. calceolus*, *M. binocularis* and *M. paxillata*. However, it can be distinguished from these species by differences in scale and bristle morphology. It was previously reported from different parts of the world, but its taxonomic status remained unrecognized due to the lack of a detailed investigation of cultured material. The taxonomy and distribution of the species are discussed and compared with information in the literature.

Key words: algae, Czech Republic, *Mallomonas*, new species, Synurophyceae

Introduction

The *Mallomonas* species described in this paper, *M. kalinae* sp. nov., belongs to the section *Papillosae*. Together with other *Mallomonas* species (Nováková et al. 2004) it was collected in May 2001 from a peat bog situated in the Bohemian Switzerland National Park, northern Bohemia. Previously, similar scales were recorded as *M. cf. rasilis* from Malaysia, Australia and Papua New Guinea (Dürschmidt & Croome 1985, Vyverman & Cronberg 1993), and as *M. rasilis* from Australia and Central Europe (Croome & Tyler 1988, Hartmann & Steinberg 1989). The description of this taxon is based on studies using both electron and light microscopy.

Material and methods

The material was collected from a small peaty pool (depth of about 20 cm, water temperature 16 °C, pH 5.5, conductivity 56 µS/cm) at the locality Ostrov, 3 km NE of the Tisá village (14°02'43,9" N, 50°48'35,4" E, see Nováková et al. 2004) in the Bohemian Switzerland National Park, on 31 May 2001. The species was isolated by pipetting and culturing in Erlenmeyer flasks in DY IV medium (Andersen 1997) under laboratory conditions at room temperature and natural daylight conditions.

To prepare the cells for scanning electron microscopy (SEM), about 5 ml of culture suspension was filtered using a Millipore polycarbonate filter (3.0 µm pore size). Cells were fixed at room temperature in 1% OsO₄ buffered with the culture medium for 1 hour in the Millipore column. The fixative was then diluted with distilled water and the cells on the filter were dehydrated through a graded ethanol series. The filter with cells attached was

transferred subsequently to a vial of 100% ethanol and was critical point-dried with CO₂ (Bal-Tec CPD 030). The dried filter was mounted with double-stick tape to a glass coverslip mounted onto an aluminium stub and then sputter-coated with platinum-palladium for 30 seconds using a model JEOL JFC 2300 HR. The samples were observed using a JEOL JSM-6400 scanning electron microscope operated by the Institute of Biology, University of Copenhagen.

For transmission electron microscopy (TEM), the samples were gently rinsed with distilled water in a centrifuge, dried on to Formvar coated copper grids and shadowcast with chromium (Němcová et al. 2002). The grids were examined using a transmission electron microscope Philips T 300 operated by the Department of Botany, Charles University, Prague.

The LM photographs were taken using Olympus Z300 microphotograph equipment attached to an Olympus BX51 light microscope. The strain (number B 601) is kept in The Collection of Algae of Charles University, Prague, Czech Republic (CAUP) (Nováková & Neustupa 2005).

Results

Mallomonas kalinae Řezáčová spec. nova

Latin diagnosis: Cellulae ellipsoidae, 15.0–17.5 µm longae, 8.0–9.5 µm latae, squamis cupuliferis tectae. Squamae tripartitae (3.7–3.9 × 1.7–2.0 µm), cupula parva aut sine papillis dissipatis ornata. Scutum papillis aequidistanter dispositis ornatum. Pori singuli sive bini circumvallati in angulo cristae v-formis dispositi. Costae submarginales distinctae adulti. Limbi inornati. Squamae postremae circiter 2.5 µm longae, 1.3 µm latae, squamis corporis minores. Setae 4.1–7.3 µm longae, exigue curvatae et acutae. In parte anteriore cellulae setae basaliter extensae ad apicem acutum attenuatae. Cystae ignotae.

Iconotypus: in stagno turfoso, Ostrov apud Tisá, distr. Ústí nad Labem, Bohemia, die 31 Martii anni 2001, inventus. Iconotypus Figura mea 2c.

The epithet is dedicated in honour of the phycologist Tomáš Kalina, Czech Republic.

Cells are ellipsoidal (15.0–17.5 × 8.0–9.5 µm) and are covered with domed scales each bearing a bristle (Fig. 1c, some bristles were damaged during fixation). The scales (3.7–3.9 × 1.7–2.0 µm) are tripartite with a small and smooth dome. The shield is marked with small papillae, which are regularly spaced and arranged in rows. Distinct base plate pore or occasionally two pores are situated in the proximal area of the shield at the base of the V-rib. This area is mostly devoid of papillae (Figs 2a, b, c). Anterior submarginal ribs are well developed. The posterior and anterior flanges are smooth, the posterior flange is bordered with a smooth upturned rim. The rear scales are smaller than the body scales (ca. 2.5 × 1.3 µm). Bristles are 4.1–7.3 µm long, smooth, slightly curved and pointed. Cysts were not observed.

Discussion

Mallomonas kalinae belongs to the section *Papillosae* Asmund et Kristiansen and within that section is similar to *M. rasilis* Dürschmidt, *M. calceolus* Bradley, *M. binocularis* Siver and *M. paxillata* (Bradley) Péterfi et Momeu (Kristiansen 2002). The species most similar to *M. kalinae* is *M. rasilis*, and therefore it was designated as *M. cf. rasilis* in earlier

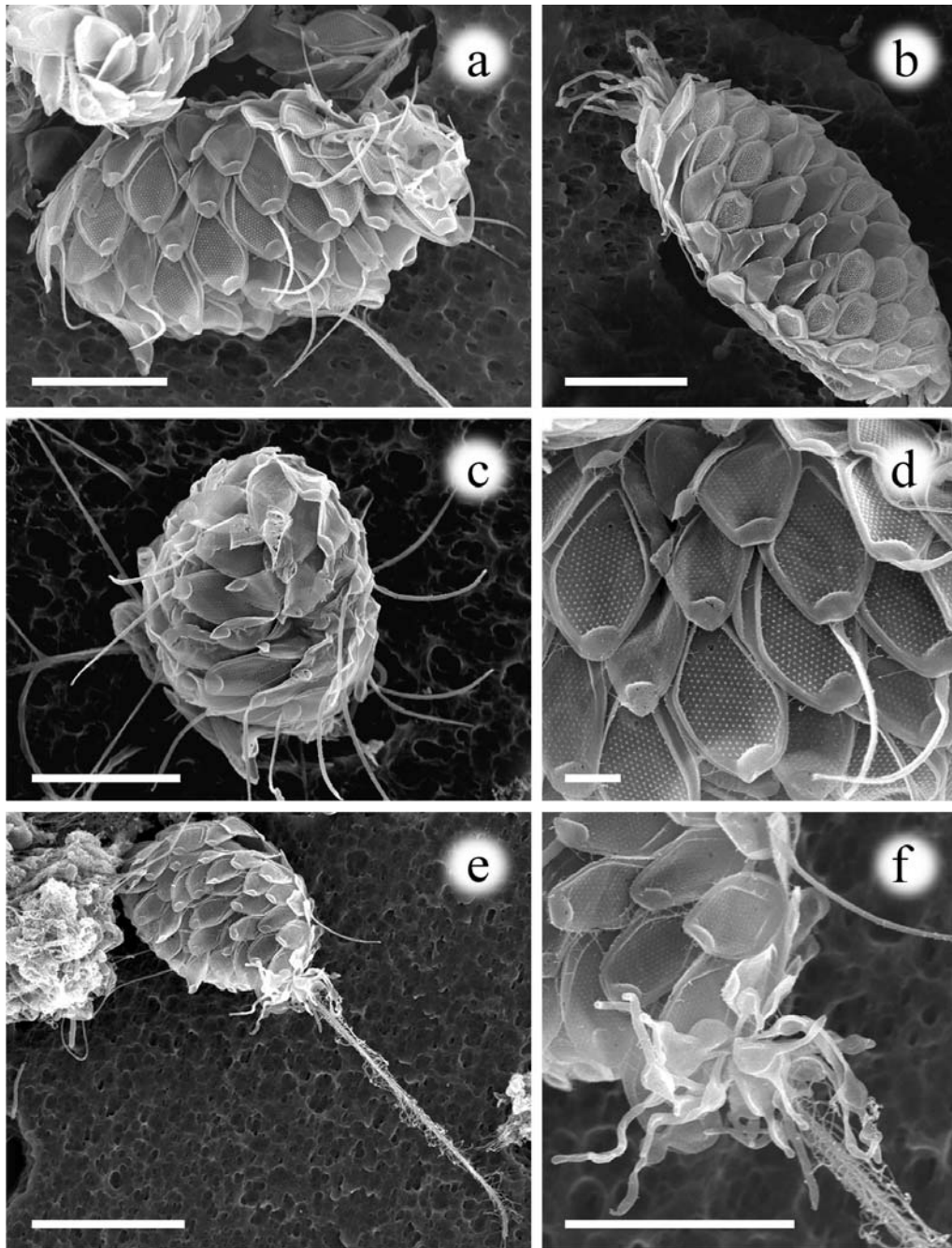


Fig. 1. – *Mallomonas kalinae* sp. nov. (SEM): a–c – Entire cells. Scale bars indicate 5 μm; d – Group of body scales. Scale bar indicates 1 μm; e – Entire cell with one flagellum. Scale bar indicates 10 μm; f – Detail of deformed scales. Scale bar indicates 5 μm.

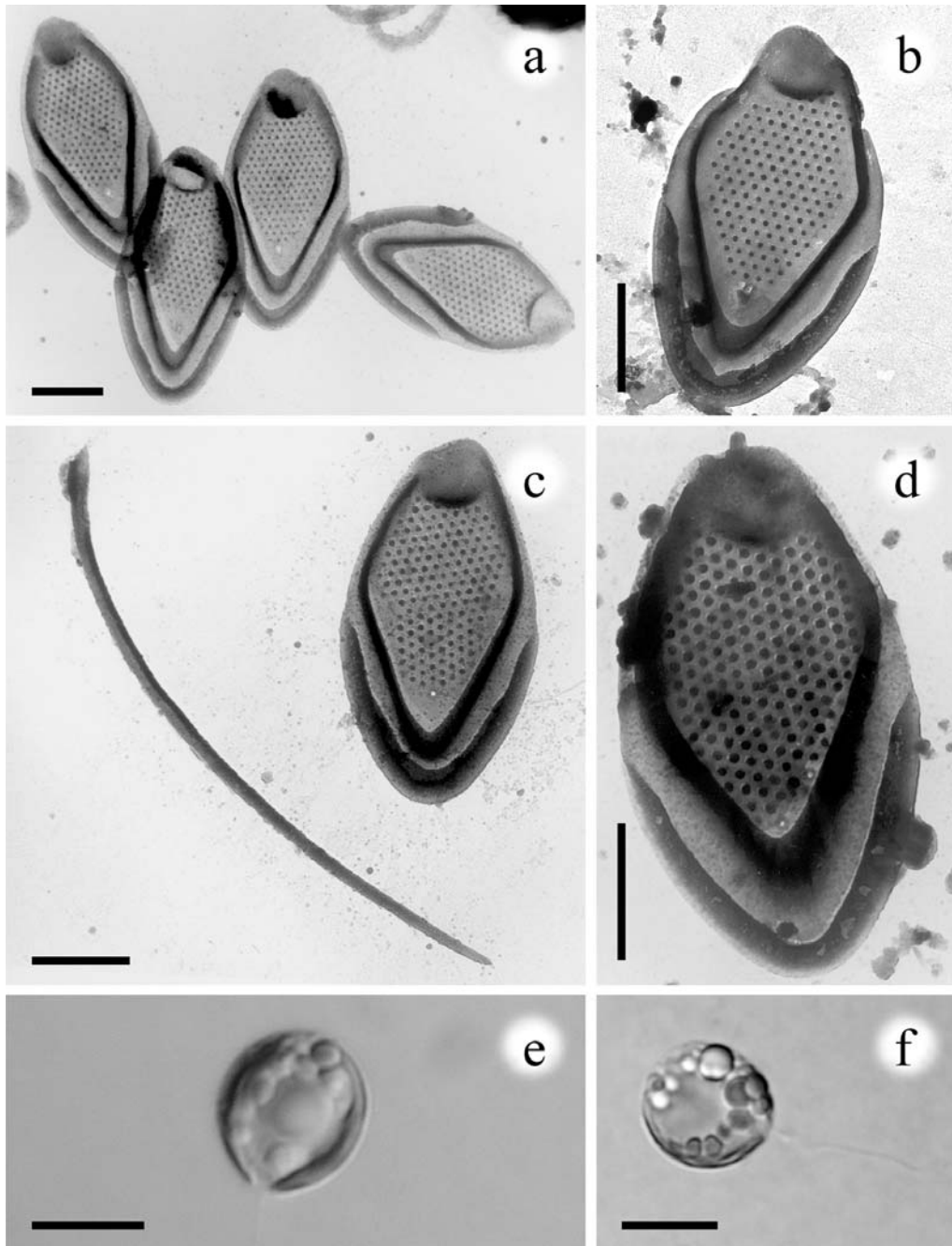


Fig. 2. – *Mallomonas kalinae* sp. nov. (TEM, LM): a – Group of body scales. Scale bar indicates 5 μ m; b – Body scale with reduced anterior flanges. Scale bar indicates 5 μ m; c – Body scale and bristle. Scale bar indicates 5 μ m; d – Body scale with two pores. Scale bar indicates 5 μ m; e–f – Cells from the culture. Scale bars indicates 10 μ m.

studies (Dürschmidt & Croome 1985, Vyverman & Cronberg 1993). The scales of *M. kalinae* differ from those of *M. rasilis* Dürschmidt in having well-developed anterior submarginal ribs, lacking papillae on the anterior flanges and having only smooth proximal borders. The scales are also narrower than those of *M. rasilis*. In addition, the bristles of *M. rasilis* are unilaterally serrate with short pointed teeth and therefore unlike those of *M. kalinae*. Vyverman & Cronberg (1993) record that their *M. cf. rasilis* designated cells had scales with the dome on one side half covered with papillae. The cells are more elongate ($23.0\text{--}23.9 \times 5.6\text{--}6.4 \mu\text{m}$) with slightly broader and longer scales ($4.2 \times 2.1\text{--}2.6 \mu\text{m}$) and somewhat longer bristles ($9.5\text{--}12.0 \mu\text{m}$) than those of *M. kalinae*. In spite of this, these cells are considered to be *M. kalinae* due to the presence of certain structural features, especially scales with distinct anterior submarginal ribs. The shield on the scales of *M. calceolus* Bradley is marked with widely spaced and scattered papillae instead of the densely and regularly spaced papillae present on *M. kalinae* scales. Scales of *M. calceolus* also lack the pore in the angle of the V-rib and the distal ends of the bristles are bifurcate. *Mallomonas kalinae* also resembles *M. binocularis* Siver in having bristles and papillae on the shield. However, *M. binocularis* lacks anterior submarginal ribs and at the base of the V-rib has two conspicuous pores resembling a pair of eyes (Siver 2002). Interestingly, several scales of *M. kalinae* with two pores have also been found (Fig. 2d), but these are in a different position than those of *M. binocularis*. Siver (2002) discussed the significance of the rimmed pores within Section *Papillosae*, specifically in the case of *M. papillosa* and *M. binocularis*, and emphasized their importance for specific delimitation. As was demonstrated here, populations can include a few cells bearing some atypical scales. Finally, *M. kalinae* differs from *M. paxillata* (Bradley) Péterfi et Momeu in the absence of a well developed anterior submarginal rib that extends past the dome forming a forward-pointing “tooth”, and in lacking papillae on the anterior flanges. In addition, the scales of *M. kalinae* have a pore in the base plate and the distal ends of bristles lack bifurcate tips.

Interestingly, at the anterior end of some cultivated *M. kalinae* cells peculiar structures develop (Figs 1b, e, f). These structures are probably variously distorted and deformed scales, enlarged at the base and narrowing towards the blunt distal end (Fig. 1f). In the genus *Mallomonas* similar apical structures are known only in *M. retrorsa* (Siver 1991). However, their shape is different; being paddle shaped and widest at the distal end instead of the proximal as in *M. kalinae*. These peculiar structures in *M. kalinae* were observed only in older cultures, but it cannot be excluded that they also appear in nature.

Mallomonas kalinae has previously been found (and identified as *M. cf. rasilis* or *M. rasilis*) in oligotrophic and dystrophic waters rich in humic acids at temperatures between 26 and 28 °C, pH 5.6 and conductivity of 16 $\mu\text{S}/\text{cm}$ in Malaysia and Australia (Dürschmidt & Croome 1985), Australia (Croome & Tyler 1988) and Papua New Guinea (Vyverman & Cronberg 1993). Hartmann & Steinberg (1989) found single scales in a sample from former West Germany from water with a temperature of 11.4 °C, pH 7.3 and conductivity of 122 $\mu\text{S}/\text{cm}$. Thus, *M. kalinae* appears to prefer slightly acidic and oligotrophic water bodies and rather high temperatures. It is probably a widely distributed, but rarely occurring species. Unlike many other *Mallomonas* taxa, this acidophilic species grows well in culture, which makes it a suitable model organism for investigating the morphological variation and ontogenesis of scales (Gutowski 1996, Siver & Skogstad 1988). Including *M. kalinae*, the *Mallomonas* flora of the Czech Republic now comprises 42 taxa (Němcová et al. 2003, Nováková et al. 2004, Řezáčová et al. 2004).

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Souhrn

Nový druh rodu *Mallomonas*, *M. kalinae* sp. nov., je popsán z malé rašelinné tůně, z lokality Ostrov v NP Českosaské Švýcarsko (severní Čechy). Na základě morfologických charakteristik se tento druh řadí do sekce *Papillosae* a podobá se druhům *M. rasilis*, *M. calceolus*, *M. binocularis* a *M. paxillata*. Od těchto druhů se odlišuje ornamentací šupin a strukturou ostnů. Byl již zaznamenán v několika floristických publikacích z různých částí světa, avšak s nejistým určením. Detailnější informace o struktuře křemičitých struktur přineslo až studium bičíkovce udržovaného v kultuře v laboratorních podmínkách. Taxonomie a rozšíření tohoto druhu je dále diskutována a porovnávána s literárními údaji.

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