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MALLOMONAS CRONBERGIAE (CHRYSOPHYCEAE, STRAMENOPILES), A NEW SPECIES FROM THE GUINEO-CONGOLIAN RAINFOREST IN CAMEROON

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Abstract. A new species of *Mallomonas* Perty, *M. cronbergiae* J. Piątek *sp. nov*., was found in a tropical shallow stream pool in the Guineo-Congolian rainforest in Cameroon. It belongs to the series *Ouradiotae* and is similar to the three other *Mallomonas* taxa from this series, namely *M. ouradion* Harris & Bradley, *M. parvula* Dürrschmidt and *M. parvula* var. *nichollsii* Wujek & Bland, but differs in some morphological characters that clearly differentiate *M. cronbergiae* as a distinct species. The new species has a different size of scales, characteristic 3–7 pores at the posterior rim, an anterior flange ornamented with papillae, and a shield thickly ornamented with papillae (14–16 per scale width). The species is described and illustrated with the use of light and scanning electron microscopy.

Key words: Africa, Cameroon, Chrysophyceae, *Mallomonas*, new species, scale morphology

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Introduction

The genus *Mallomonas* Perty (1852) comprises solitary, flagellated cells covered by silica scales and (sometimes) bristles. Its members usually occur in freshwater habitats. In electron microscopy the ultrastructure of *Mallomonas* scales and bristles proved to be a reliable taxonomical feature enabling distinction between species (Asmund & Kristiansen 1986; Siver 1991). In this study we describe a new *Mallomonas* species from Cameroon, belonging to the series *Ouradiotae* Asmund & Kristiansen (1986).

Previously only three taxa were included in the series: *M. parvula* Dürrschmidt (1982), *M. parvula* var. *nichollsii* Wujek & Bland (1988) and *M. ouradion* Harris & Bradley (1958). Despite the quite ubiquitous distribution of two of them (*M. parvula*, *M. ouradion*) (Kristiansen & Preisig 2007) there was no record from Africa yet. One of them (*M. parvula* var. *nichollsii*) is known only from North America (Florida) (Wujek & Bland 1988). Features that characterize the series are the absence of a dome and the presence of a broad V-rib. Additionally, the scales are ornamented with papillae and the secondary layer has a somewhat incomplete appearance (Kristiansen 2002).

Materials and methods

The materials were collected on 12 December 2007 from the edge of a shallow stream pool in the Guineo-Congolian rainforest in the East Region of Cameroon (Fig. 1). Plankton water and sediment were taken with a pipette. The samples were fixed with Lugol's solution. Immediately after collection, water temperature (°C) and conductivity ($\mu S \cdot cm^{-1}$) were measured with a CC-102 conductivity meter (Elmetron IP67), and pH with a CP-103 waterproof pH-meter (Elmetron IP67).

The specimens were examined and identified using standard light and phase contrast microscopy (LM) and scanning electron microscopy (SEM). Slide preparations mounted in water were studied using a Nikon Eclipse 600 light microscope. Micrographs were taken with a Nikon DS-Fi1 camera. For SEM observations, each sample was pipetted onto clean cover glasses, air-dried, and affixed to an aluminum stub with double-sided transparent tape. The stubs were sputter-coated with carbon

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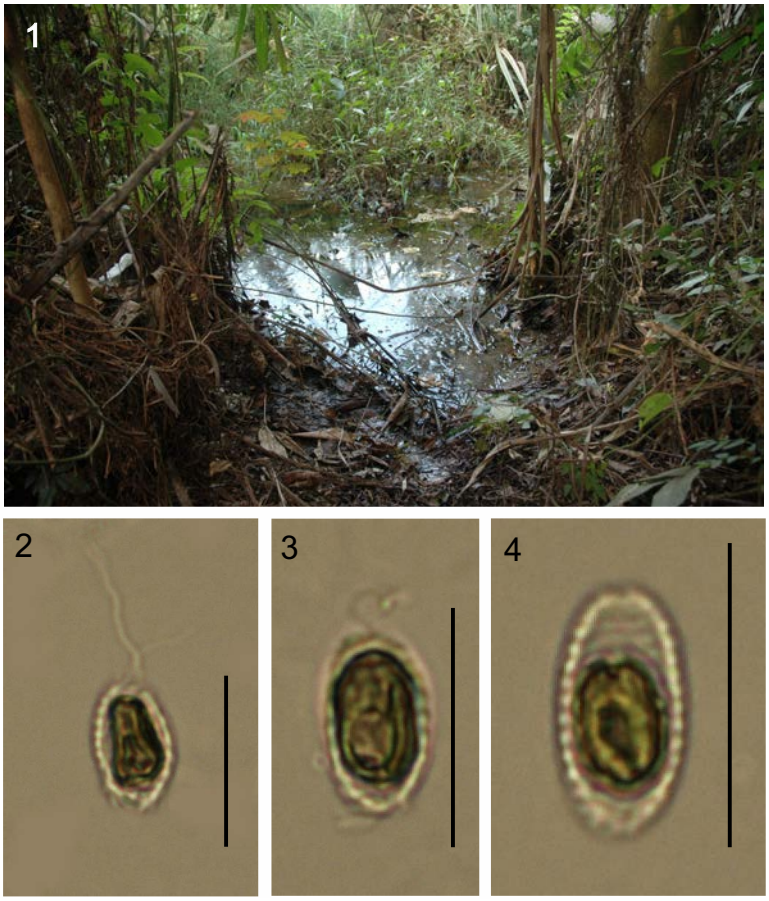


Figs 1–4. *Mallomonas cronbergiae* J. Piątek, *sp. nov.* 1 – Sampling site (type locality) – edge of stream pool in Guineo-Congolian rainforest (photo M. Piątek). 2–4 – Whole cells with scales and bristles seen by LM. Scale bars for LM = 20 µm.

using a Cressington sputter-coater and viewed with a Hitachi S-4700 field emission scanning electron microscope.

The description of the new *Mallomonas* species follows the terminology of Sivier (1991), Kristiansen (2002) and Kristiansen and Preisig (2007). All measurements were taken directly from the collected material, under LM for cells and from SEM micrographs for scales and other elements.

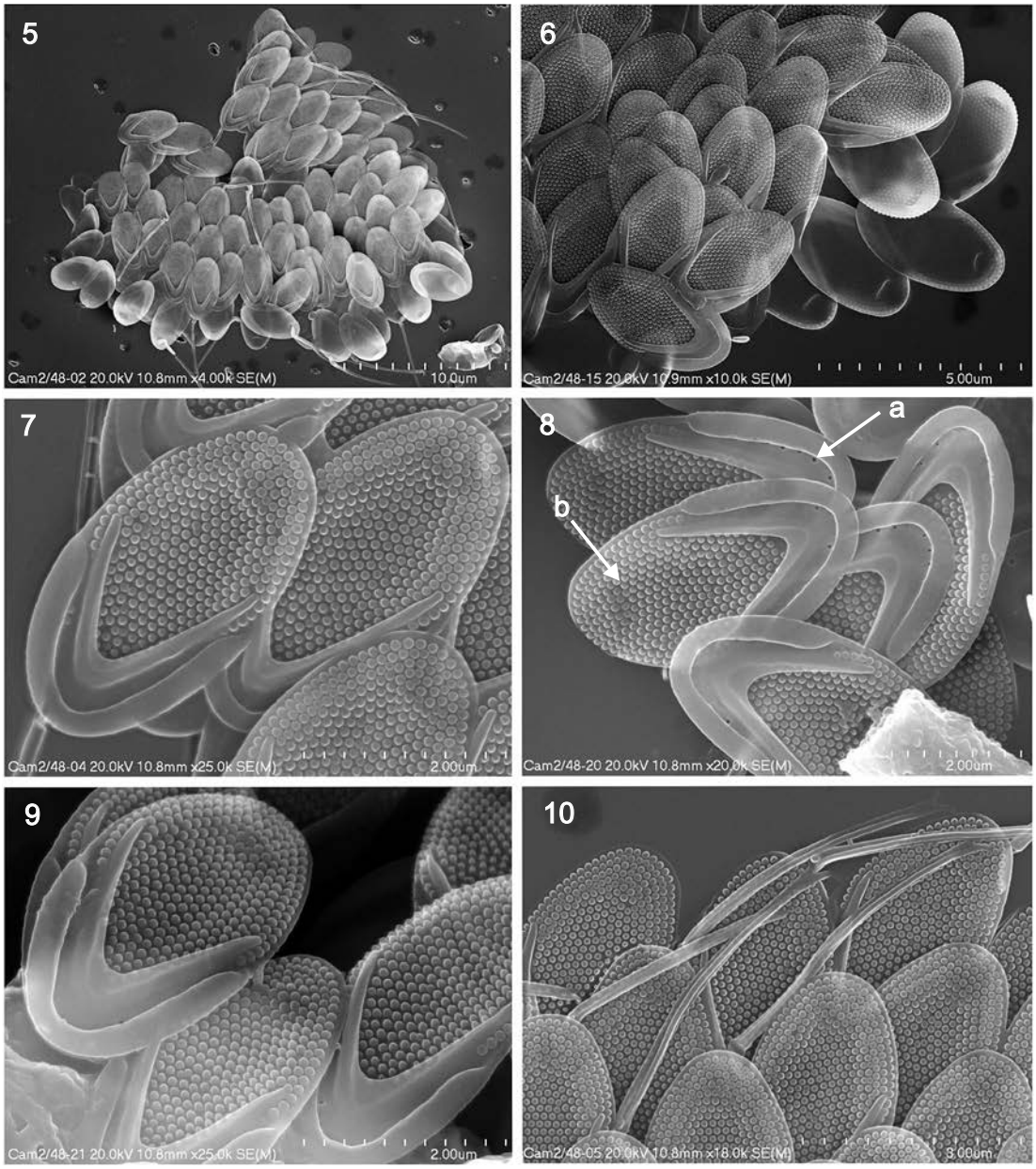
Results

Mallomonas cronbergiae J. Piątek, ***sp. nov***.
Figs 2–10

LM description. Cells oval with bristles, with at least one chloroplast and two flagella. Cells 13.7–17.6 µm long and 8.6–9.6 µm wide.

SEM description. Scales elliptical and symmetrical, 3.2–4.0 µm long and 2.0–2.3 µm wide. Posterior rim encircling half or almost half of scale perimeter. Well-developed V-rib separating shield from posterior flange. Shield covered with densely spaced, well-developed papillae. Papillae 0.07 µm in diameter, 14–16 per scale width (counted where V-rib ends). Posterior flange smooth, with 3–7 pores/holes at base of posterior rim. Bristles smooth, short, thick, slightly curved, with bifurcated distal tip (sometimes not bifurcated), 3.5–5.8 µm long and 0.2–0.3 µm wide. Stomatocysts not observed.

Type: CAMEROON, East Region, Department of Lom-et-Djérem: between Boni and Kagama, *ca* 10 km



Figs 5–10. *Mallomonas cronbergiae* J. Piątek, *sp. nov.* seen by SEM. 5 – Scales covering the cells. 6–9 – Group of scales with characteristic markings: (a) scales have 3–7 pores/holes at base of posterior rim, (b) shield is thickly ornamented with papillae (14–16 per scale width, counted where V-rib ends); 8 – holotype. Individual diagnostic features are arrowed. 10 – Smooth, thick, slightly curved bristles with bifurcated distal tip.

SW of Bertoua, 04°30′38.2″N, 13°36′53.5″E, elev. *ca* 652 m a.s.l., 12 December 2007, *leg. J. Piątek* (HOLOTYPE: Fig. 8).

ETYMOLOGY. The species is named in honor of the eminent phycologist Professor Gertrud Cronberg, who, among other studies, worked on the

Table 1. Comparison of *Mallomonas cronbergiae* J. Piątek, *sp. nov.* with morphologically similar taxa (morphological characters according to Wujek & Bland 1988; Siver 1991; Kristiansen 2002; Kristiansen & Preising 2007).

Species	Cells	Scales	Shield	Posterior rim	Posterior flange	V-rib	Number of papillae per scale width*	Bristles
M. cronbergiae	oval, 13.7–17.6 × 8.6–9.6 µm	elliptical, symmetrical 3.2–4.0 × 2.0–2.3 µm	thickly ornamented with papillae, 0.07 µm in diameter	encircling half or almost half of scale perimeter	smooth, with 3–7 pores at base of posterior rim	well developed	14–16	short, smooth, thick, slightly curved, with bifurcated distal tip, 3.5–5.8 µm long × 0.2–0.3 µm wide
M. ouradion	ellipsoidal, ovoid, 11.0–33.0 × 7.0–12.0 µm	oval, elliptical, symetrical, 5.0–7.0 × 2.5–4.0 µm	with papillae	encircling less than half of scale perimeter	smooth	hooded	7–9	short, thick, bifurcated, slightly curved, 4–12 µm long
M. parvula	spherical, obovate, rhomboid, 10.0–15.0 µm	obovate, rhomboid, 1.6–2.2 × 1.3–1.4 µm	with papillae	broad with V-rib	covered by broad hood of posterior rim	with rounded base and V-shaped windows	10–13	short, slightly curved, bifurcated, 4.0 µm long
M. parvula var. *nichollsii*	spherical, obovate, rhomboid, 10.0–15.0 µm	2.1–2.7 × 1.0–1.6 µm	with papillae	with V-rib	no data	well developed	12–13	3.8–5.0 µm long, with small projections on lower one-third of bristles

* Counted in place where V-rib ends

chrysophytes of the Tropics and published several papers on this group of algae.

Distribution. This new *Mallomonas* species is known only from the type locality in Cameroon.

Habitat. The sample was collected in a semi-shaded place in rainforest from the edge of a shallow stream pool rich in decaying leaf litter (Fig. 1). The water was black, with temperature 24°C, conductivity 24 $\mu S \cdot cm^{-1}$ and pH 6.39. The species co-occurred with other algae, especially with many different specimens of Cyanophyta and Bacillariophyceae, and single specimens of Euglenophyta.

Notes. *Mallomonas cronbergiae* has several unique morphological features that justify its description as a new species: size of scales (3.2–4.0 × 2.0–2.3 μm), 3–7 pores at posterior rim, anterior flange ornamented with papillae, and shield thickly ornamented with papillae (14–16 per scale width). This species is assigned to series *Ouradiotae* and is similar to the three other taxa from this series, which are contrasted and discussed below (Table 1).

Discussion

Mallomonas ouradion differs from *M. cronbergiae* in having almost twice larger scales (5.–7. × 2.5–4.0 μm – Siver 1991; Kristiansen 2002; Kristiansen & Preisig 2007). Moreover, *M. ouradion* has *ca* 7–9 papillae per scale width (counted where V-rib ends), whereas *M. cronbergiae* has 14–16 papillae. It is striking that *M. cronbergiae* has twice smaller scales, with more papillae per scale width than *M. ouradion*. Additionally, *M. cronbergiae* differs from the latter species in having 3–7 pores/holes located at the base of the posterior rim (they are absent in *M. ouradion*).

Mallomonas parvula and *M. parvula* var. *nichollsii* differ in having spherical cells and smaller scales, 1.3–1.4 × 1.6–2.2 μm (Wujek & Bland 1988; Siver 1991; Kristiansen 2002; Kristiansen & Preisig 2007). The cells of *M. cronbergiae* are oval and the scales are more than twice longer than in the latter species. The number of papillae per scale width is another characteristic differentiating the three taxa: 10–13 papillae in *M. parvula* and 12–13 papillae in *M. parvula* var. *nichollsii*, versus 14–16 papillae in *M. cronbergiae*. Furthermore, the latter species has 3–7 pores/holes located at the base of the posterior rim, features absent in *M. parvula* and *M. parvula* var. *nichollsii*.

Recently another new species was found in the materials from Cameroon: *M. camerunensis* J. Piątek (2015), which belongs to the series *Papillosa* Asmund & Kristiansen (1986). As pointed out by Němcová and Kreidlová (2013), even though records of new *Mallomonas* species are continuously published, it seems that the number of species and their distribution may be underestimated.

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