Pseudocarteria corcontica, a new quadriflagellate species (*Volvocales*)

Pseudocarteria corcontica* – nový druh bičíkovce z řádu *Volvocales

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A new species *Pseudocarteria corcontica* is described from small, acidic and oligotrophic water bodies in the Krkonoše Mts (Czech Republic). The cells are 17–27 × 22–35 μm in size, ellipsoidal or obovate and with a low truncate papilla. The thick cell wall is sometimes separated from the protoplast at the posterior end of the cell. The chloroplast is indistinctly asteroid with an ellipsoidal or half-ellipsoidal pyrenoid located below the centre of the cell. Numerous contractile vacuoles are not scattered as in other *Pseudocarteria* species, but mostly concentrated in the upper third of the cell and form circle beneath the cell wall. A small elliptical stigma is located in the anterior part of the cell. Cells divide in immobile sporangia (up to 38 μm in diameter) producing 2 or 4 daughter cells. Sexual reproduction is isogamic.

K e y w o r d s : Czech Republic, Krkonoše Mts, quadriflagellate, *Pseudocarteria*, *Volvocales*

Introduction

The genus *Pseudocarteria* Ettl was detached from the genus *Carteria* Diesing em. Francé because it has an axial or parietal chloroplast and numerous, scattered contractile vacuoles (Ettl 1958). However, recent studies of quadriflagellate volvocalean algae indicate that there are two phylogenic groups within the genus *Carteria*: *Carteria* group I with a typical V-shaped flagellar apparatus and *Carteria*-group II with swastika-shaped anterior papillae. The differences are supported at the ultrastructural level (Lembi 1975) and by a molecular comparison of chloroplast multigene sequences (Nozaki et al. 2003). According to Nozaki et al. (2003) *Pseudocarteria* is related to *Carteria* I group. Nevertheless, the question remains open, whether these two genera should be re-combined or the genus *Carteria* split into two.

According to Ettl (1983) the genus *Pseudocarteria* contains four species: *P. pallida* (Korshikov) Ettl, *P. stellata* (Korshikov) Ettl, *P. peterhofiensis* (Kisselev) Ettl and *P. mucosa* (Korshikov) Ettl. Details of the morphology and life cycle are known only for *P. mucosa* (Suda et al. 1990, Suda & Watanabe 1995).

During an investigation of the algal flora of subalpine mires in the Krkonoše Mts (Czech Republic) quadriflagellates belonging to the genus *Pseudocarteria* were frequently observed. However, they did not resemble any of the described species.

Material and methods

The samples with *Pseudocarteria corcontica* spec. nova were collected in 2002–2004 from small water bodies in the vicinity of the Úpské rašeliniště peat bog (1420 m a.s.l.) in the Krkonoše Mts (English equivalent: Giant Mts).

Samples were examined at the latest within two days of collection and then cultivated under a day/night regime at 10–15°C. Motile flagellates were observed in these samples for up to a month after collecting. Unfortunately, attempts to produce one-species cultures proved unsuccessful.

Results

Pseudocarteria corcontica Nováková**, spec. nova**

Diagnosis: Cellulae ellipsoidae vel obovatae; membrana cellularum crassa, ad 2 μm lata, interdum incrassata in parte caudali et a protoplasto saepe discedens; papilla breve truncata, flagella quattuor 1,2-plo longior quam cellulae; chromatophorum centrale, indistincte stellatim dissectum, pyrenoides magnae in centro chromatophoris locatae, cum granulis amyloideis numerosis involutae; stigma minutum, ellipticum in parte anteriori cellulae locatum; vacuolae contractiles plures, in partibus cellularum anterioris, praecipue in triente anteriori circulatim ad parietes dispositae. Reproductio asexualis divisione protoplasti in 2–4 cellulas filiales. Reproductio sexualis isogamica.

Dimensiones: Cellulae vegetativae 22–35 μm longae et 17–27 μm latae, zoosporangia ante divisionem ad 38 μm diametro.

Habitatio: In solo acido oligotrophico in Montibus Corconticis (Bohemia septentrionalis).

Holotypus (Iconotypus): Figura nostra 1b.

Cells are 22–35 μm long and 17–27 μm broad, ellipsoidal or obovate in shape, with four flagella about 1.2× longer than the cell. The cell wall is 1–2 μm thick with a low truncate papilla, often thickened at the posterior end of the cell and sometimes also about 1/4 of the cell length from the apex (Fig. 1b). The protoplast is often separated from the cell wall, mainly at the posterior end (Fig. 2d). The chloroplast is axial, indistinctly asteroid with a large ellipsoidal or half-ellipsoidal pyrenoid, surrounded by a number of starch plates and positioned below the centre of the cell. A small oval stigma is located in the anterior part of the cell. Numerous contractile vacuoles are mostly concentrated in the upper third of the cell in the form of a circle beneath the cell wall. Only a few vacuoles are visible in the posterior part of the cell. It was not possible to determine the exact position of the nucleus.

Moving cells often seemed to have striated chloroplasts. Closer observation revealed longitudinal rows of dots on the surface of the cells (Figs 1c, d). However, the empty cell walls were smooth. Probably the dots covered the surface of the protoplast or the dotted layer of the cell wall dissolved when the cell died.

Vegetative cells propagate in immobile sporangia (up to 38 μm in diameter) producing 2 or 4 daughter cells, which are about 20 μm long and 16 μm wide (Fig. 2f). Sexual reproduction takes place isogamically (Fig. 1e).

Pseudocarteria corcontica occurred in small acidic water bodies (pH 3.7–4.3) with low conductivity (13–50 μS/cm) in the vicinity of the peat bog (but not in the peat bog) together with other algae (e.g. *Aulacoseira distans* var. *nivalis, Penium cylindrus, Pinnularia rupestris, Asterococcus superbus, Binuclearia tectorum, Netrium digitus*) and cyanophytes (e.g. *Chroococcus subnudus*). This species lived mainly in the benthos and

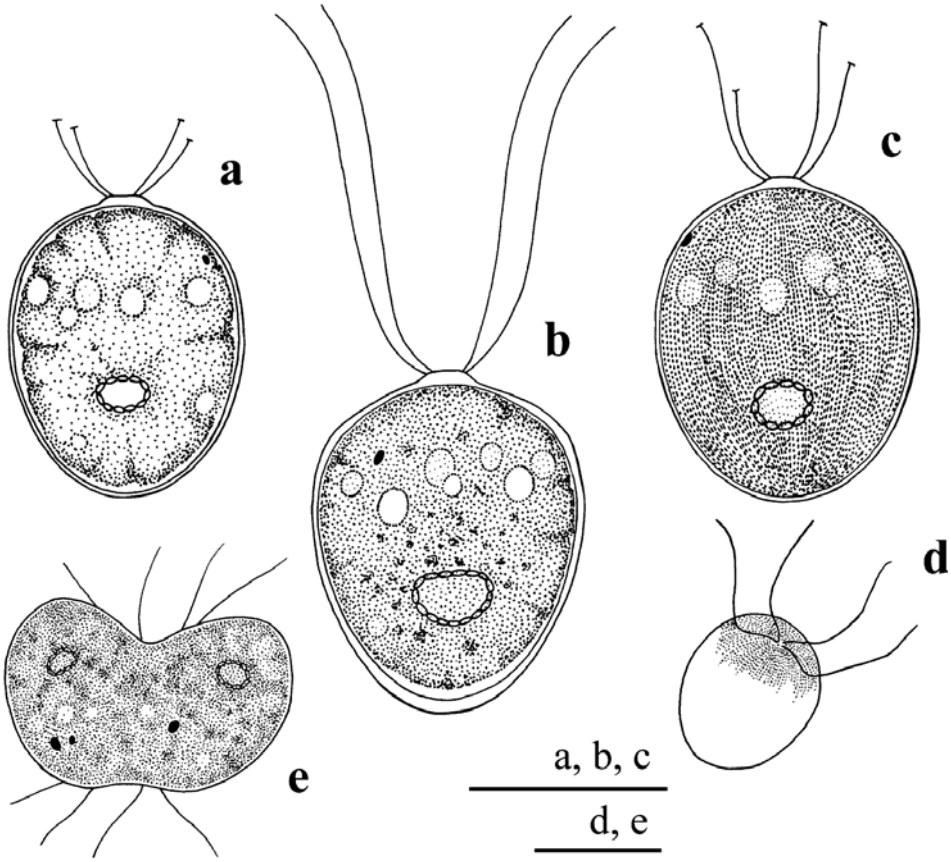

Fig. 1. – *Pseudocarteria corcontica* spec. nova. a–c: vegetative cells; d: detail of the dotted surface in the apical part of the cell; e: isogamic process. Bar = 20 µm.

metaphyton and rarely in the plankton. The abundance of this species in samples fluctuated independently of weather and environmental conditions. It seems to tolerate drying well as some of the pools where *P. corcontica* occurred regularly dried out during summer.

Discussion

The new taxon differs from the other species of the genus *Pseudocarteria* mainly in the arrangement of the contractile vacuoles, the shape of the cells and structure of the cell wall.

In the dimensions of its cells, four flagella, a thick cell wall, an asteroid chloroplast and similar autecology this species resembles *Tetratoma schussnigii* Ettl (Ettl 1968). A multiple stigma, which is typical of *T. schussnigii*, was also rarely observed in *Pseudocarteria corcontica*. Nevertheless, *P. corcontica* lacked the remote insertions of flagella, which is a generic feature of *Tetratoma,* and it also differed in the distribution of contractile vacuoles.

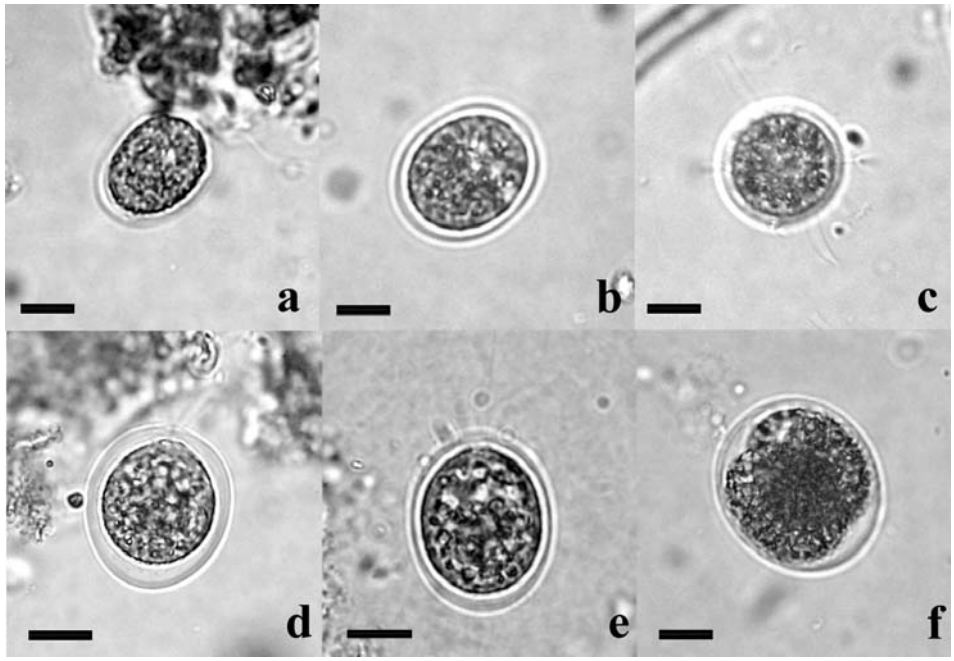

Fig. 2. – *Pseudocarteria corcontica* spec. nova. a, b, d, e: vegetative cells, lateral view; c: vegetative cell, apical view; f: sporangium. Bar = 10 µm.

The contractile vacuoles forming a girdle in the upper third of the cell are the most distinct feature of this species. This distribution of the vacuoles seems to be unique among volvocalean flagellates. The concentration of contractile vacuoles in the anterior part of the cell is described for some *Chlamydomonas* species (*C. pertyi* Goroshankin, *C. tarda* Pascher), however, their vacuoles are irregularly scattered (Ettl 1983).

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Souhrn

Nový druh zeleného bičíkovce *Pseudocarteria corcontica* byl popsán z tůní poblíž Úpského rašeliniště v Krkonoších. Buňky o rozměrech 22–35 × 17–27 µm mají elipsoidní nebo obvejčitý tvar. Poměrně hrubá buněčná stěna tvoří vepředu nízkou tupou papilu, z níž vybíhají čtyři bičíky, přibližně 1,2krát delší než buňka. Někdy je buněčná stěna navíc prstencovitě nebo bazálně ztlustlá a často odstává od protoplastu, zejména v bazální části. Chloroplast je nevýrazně hvězdicovitý s centrálním pyrenoidem elipsoidního nebo subelipsoidního tvaru umístěným v dolní třetině buňky. Početné pulsující vakuoly nejsou rozptýlené mezi laloky chloroplastu jako u dosud známých druhů rodu *Pseudocarteria*, ale jsou soustředěny převážně v jedné rovině po obvodu buňky, přibližně v horní třetině buňky. V apikální části buňky se nachází malé stigma. Dvě až čtyři dceřiné buňky vznikají v nepohyblivých sporangiích (do průměru cca 38 µm). Pohlavní proces probíhá isogamicky.

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