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A new freshwater chrysophyte, *Chrysomorula cohaerens gen. et sp. nov.* (Chrysophyceae, Chrysocapsaceae) from North America

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Abstract

A new freshwater chrysophyte genus and species, *Chrysomorula cohaerens*, is described from the United States. *Chrysomorula cohaerens* is a distinct taxon of non-motile heterokont chrysophyte. It forms macroscopic mucilaginous colonies attached to aquatic macrophytes, filamentous algae, and other substrata. Each colony is initially held together forming a hollow sphere by the confluence of its cell walls. The colony is at first a sphere, becoming ovoid to irregular with growth in size. Thus, it differs from other similar chrysophyte genera such as *Heimiochrysis* and *Chalkopyxis*. Cells bear pseudocilia.

Introduction

There are numerous genera of golden-brown algae (Chrysophyta, Chrysophyceae) living in freshwater habitats. Reports of their distribution had been scattered throughout the algal literature for a long time, but only recently have these been summarized for North America (Nicholls & Wujek 2003). Several more genera have recently been added: Wujek (2006), Andrews and Wujek (2009), and Nicholls (2013).

This paper reports and describes a new chrysophycean alga *Chrysomorula cohaerens* from Maryland, Kansas and Michigan.

Material and methods

Samples containing *Chrysomorula cohaerens* were collected from the following sites: Maryland (Harford County, ephemeral pond, Belcamp), Kansas (Douglas County, an I-70 turnpike marsh, west of Lawrence), and Michigan (Charlevoix County, Greene's Lake, a *Sphagnum*-dominated lake on Beaver Island). All collections were taken in mid-February or May.

Light microscope observations were made with an AO Spencer or Zeiss Photoscope II microscope. Observations were made both from freshly collected material and from stock cultures grown in Petri dishes containing soil water extract or Bold's Basal Medium (Bold 1967) supplemented with additional soil water extract. Cultures were established by micropipetting portions of epiphytes with the alga remaining attached to them or by "teasing" the colonies from their substrata and placing them into the culture medium. Cultures were placed in a north facing window and illuminated using natural light. Material was abundant enough to permit the observation of a number of characteristics but nothing of the alga's reproduction, during periods up to three weeks. Some material was stained with methylene blue or iodine. Culture materials no longer survive. A sample from the type locality preserved with a 2% acid Lugol's solution has since evaporated.

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Results

Class **Chrysophyceae** Pascher 1914
Order **Chromulinales** Pascher 1910 *sensu* Kristiansen & Preisig 2001
Family **Chrysocapsaceae** Pascher 1912 *sensu* Kristiansen & Preisig 2001
Chrysomorula Wujek, *gen. nov.* (Figs. 1–4)

The cells of each colony are layered up to three deep at the periphery forming a hollow ball. As the colony grows it forms a jumbled and irregular shape. Colony is within a gelatinous matrix which is of some definition at the periphery, but arising from it are numerous very fine pseudocilia (faint lines) through a stiff gel. Pseudocilia are 92–136 µm long. Colonies are initially sessile but may become planktonic after which they become fragmented. They are up to 250 µm in diameter not including the pseudocilia. Cells are spherical to irregular. Each possesses one or two chloroplasts yellow-green to a more prevalent golden-brown color. Cells possess a few to many refractive granules. Zoospores or statospores were not observed.

Type: *Chrysomorula cohaerens* Wujek.

Etymology:—The genus name *Chrysomorula* is from the Greek "Chryso" meaning "golden colored" and the Latin "morula" meaning "hollow sphere of cells".

Chrysomorula cohaerens Wujek *sp. nov.* (Figs. 1–4)

Cells are spherical to irregular (somewhat square) by mutual compression, 5.8–6.2 µm in diameter in face view, up to 7 µm long, somewhat in groups of four. Cells possess 1–4 pseudocilia 92–136 µm long. There are one or two golden-brown (or less commonly yellow-green) parietal chloroplasts per cell. A chrysolaminarin vesicle, median nucleus and anterior contractile vacuole are prominent cell features. Pseudocilia are stationary and extend to the periphery of the gelatinous matrix. Reproduction or statospore formation was not observed.

Type:—UNITED STATES. Maryland: under the ice in an ephemeral pond, east of Belcamp, Harford County, 39.4697° N, 76.2569° W. Sample collected by R.H. Thompson, February 1944. Fig. 1. Typification of the new species is based on the illustrations hereby published, as it was impossible to preserve specimens showing the features attributed to the taxon (McNeill *et al*. 2011, ICN art. 40.5).

Etymology:—The species name *cohaerens* is from the Latin, meaning "adhering together".
Remarks:—The genus is distinctive by the nature of its macroscopic colonial habit, with cells forming a hollow sphere embedded in a matrix, and with pseudocilia extending from each cell to the periphery of the matrix. New colonies are formed by the fragmentation of the parent colony, often producing plankton forms. Cell reproduction appears to occur by binary division. Although quite rare, I have observed it primarily epiphytic on *Oedogonium*, *Microspora*, *Rhizoclonium*, and occasionally *Utricularia*. Additional USA sites in which *Chrysomorula* was observed: An I-70 turnpike marsh, west of Lawrence, Douglas County, Kansas, May 1966 and Green's Lake, Beaver Island, Charlevoix County, Michigan, May 1999.

Discussion

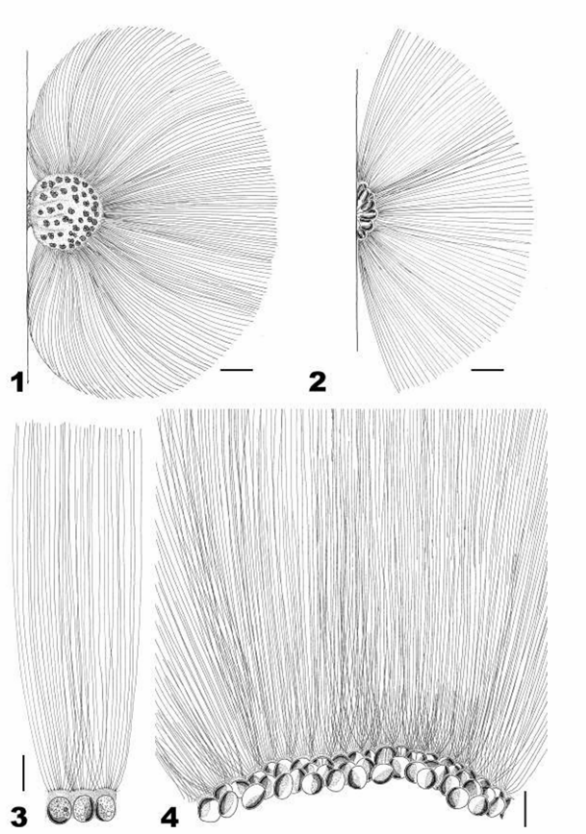
The unique generic characters of *Chrysomorula* separate it from other known chrysophytes that form gelatinous colonies. When observed with a stereo microscope, the colony appears as a golden nebula. Cells adhere to one another forming a hollow ball. Compound microscopy shows the cells bearing pseudocilia. The pseudocilia are also found in a closely related genus *Heimiochrysis* Bourrelly (1949: 272). However in Bourrelly's genus the cells in the colonies form cylindrical, sometimes branched colonies. Cells in the colonies of *Heimiochrysis* are arranged in groups of four or eight forming a cylindrical, gelatinous, sometimes

branched tubal-shaped colony. In *Chrysomorula*, the alga forms a colony held together in the form of a hollow ball by confluence of cell walls.

Chrysomorula also is excluded from *Chalkopyxis* Pascher (1931: 102). This genus lacks pseudocilia, the cells comprising its colony are arranged in groups of two or four, and the outer matrix of the colonies bizoned mucilage is radially striated.

Chrysomorula's morphology closely resembles several pseudocilian members of the green algae order Tetrasporales (e.g. *Schizochlamys* Braun ex Kützing (1849: 891) and *Octosporiella* Kugrens (1984: 88)), aggregate colonies that are nonmotile and often enclosed in a gelatinous matrix. Their most distinctive character is the presence of long pseudocilia that extend beyond the mucilage. Pseudocilia do not beat and lack the central pair of microtubules found in normal flagella axonemes (Wujek & Chamber 1965, Lembi & Herdon 1966). Placed in the Chrysocapsaceae, *Chrysomorula* is included with those chrysophytes in which the vegetative cells are without flagella and are united with one another in palmelloid colonies as in the Tetrasporaceae *sensu lato*, the homologous family of the Chlorophyceae.

I have no data on the life history of *Chrysomorula* but from its ephemeral and sporadic appearances in habitats likely to dry up, I suspect it produces a resting stage such as a stomatocyst. No evidence of phagotrophy was observed, unlike many other chrysophytes. It is quite possible *Chrysomorula* may be a palmella stage of another chrysophyte. One has only to examine the life history of the green alga *Schizochlamys* (Thompson 1956: 671) to find several "genera" that were once considered distinct. This possibility has also been suggested between the chrysophytes *Cyclonexis* Stokes (1886: 564) and *Chrysostephanosphaera* Scherffel (1911: 307) as being distinct "genera" within the same taxon (Thompson & Wujek 1998).



FIGURES 1–4. Diagrammatic representation of *Chrysomorula cohaerens* colonies. Fig. 1: Mature colony within the gelatinous matrix. Fig. 2: Early stage of ball adhering cells. Fig. 3: Cells at periphery of a maturing colony. Fig. 4: A portion of adhering cells from a developing hollow colony. Scale bars: Figs. 1–2: 25 μm; Figs. 3–4: 10 μm

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