

First record of the occurrence of *Ceratium furcoides* (Levander) Langhans 1925, an invasive species in the hydroelectricity power plant Furnas Reservoir, MG, Brazil

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(With 1 figure)

Dinoflagellates of the genus *Ceratium* are rare in freshwater. Bicudo and Menezes (2005) report the occurrence of six species of this genus in freshwater bodies around the world. In Brazil there is only one record of the genus in Branco et al. (1963).

Ceratium is considered non-toxic as it is unpalatable, but its occurrence can harm the environment since it can deplete resources. Although the toxicity of *Ceratium* has not been demonstrated, fish mortality was observed in association with *Ceratium* blooms in Thailand and Japan and attributed to oxygen depletion (Taylor et al., 1995). Also, mass death of *Ostrea lurida* (Pacific oyster) larvae was reported in Mexico (Landsberg, 2002), as well as mortality among other invertebrates (Hallegraeff et al., 1995).

Analysis of zooplankton samples collected in the Hydroelectric Power Plant of Furnas Reservoir, MG, Brazil, in the period of 13-15th March, 2007, showed the presence of the genus *Ceratium*. This reservoir belongs to the Rio Grande Basin, located in the Southeast region of Brazil (46° 19' W and 20° 40' S). The reservoir has complex basin morphology, with a dendritic shape and heterogeneous characteristics, differing widely among the several compartments formed by its arms. Thus, there are marked differences in the water quality from place to place (Delgado, 1999).

The specimens of *Ceratium* of the Furnas Reservoir was observed and photographed with an Olympus BX50 microscope. The cells were clarified with NaClO 20% to plate tabulation. The species description was based on Popovský and Pfiester (1990) and Steidinger and Tanger (1997).

The specimens of the population analyzed present characteristics that superpose to two species, *Ceratium hirundinella* (D.F. Müller) Dujardin 1841 and *C. furcoides* (Levander) Langhans, 1925. The individuals found in the samples have L/B varying from 3.1 to 3.5 which are closer to *C. hirundinella*, whereas *C. furcoides* has a ratio of 6.6 (Figure 225, p. 208, in Popovský and Pfiester, 1990). Another superposing characteristic is that the epivalve in the population varied from conical to helmet shaped,

narrowing gradually and forming a long apical horn. According to the literature the epivalve of *C. furcoides* is conical whereas in *C. hirundinella* it is elm shaped. Nevertheless, the main difference between the two species is the apical plates tabulation. *C. hirundinella* have 4 apical plates reaching the apex while in *C. furcoides* 3 apical plates reaches the apex and the 4th does not reach the apex (Figure 1).

Among the 35 stations sampled *C. furcoides* was recorded in 15. The highest densities occurred in places close to the entry point of domestic sewage effluents. Maximum mean density in the water column was 12 cells.mL⁻¹, while at the surface, densities were higher. This density is relatively low compared to those recorded by Hart (2007), who followed the temporal and spatial dynamics of blooms of the dinoflagellate *Ceratium hirundinella* in a subtropical reservoir in South Africa. Peak densities above 1000 cells.mL⁻¹ were recorded there in the year 2004.

The water of Furnas Power Plant Reservoir is highly transparent, with low conductivity (30 µS.cm⁻¹), neutral pH and mean temperatures ranging from 20-25 °C (Delgado, 1999). In general, the nutrient concentrations are low, characterizing oligotrophic conditions, although some compartments can be considered mesotrophic, due to the input of domestic sewage.

Ceratium furcoides was observed in the Feitsui Reservoir, Taiwan and its abundance was positively correlated with the concentrations of phosphorus, total organic carbon, bacterial number, and the biochemical oxygen demand in the water. This species did not appear in large numbers either and its maximum density was 75 cells.mL⁻¹ (Wu and Chow, 1998).

In an eutrophic lake in Poland, Stephaniak et al. (2007) observed that *Ceratium furcoides* can better compete for nutrients with cyanobacteria, probably due to its vertical migration capacity

Ceratium furcoides is very similar to *Ceratium hirundinella* and it has been considered, in the past, a variety of this latter species. Blooms of *Ceratium hirundinella* (D.F. Müller) Dujardin 1841 have been ob-

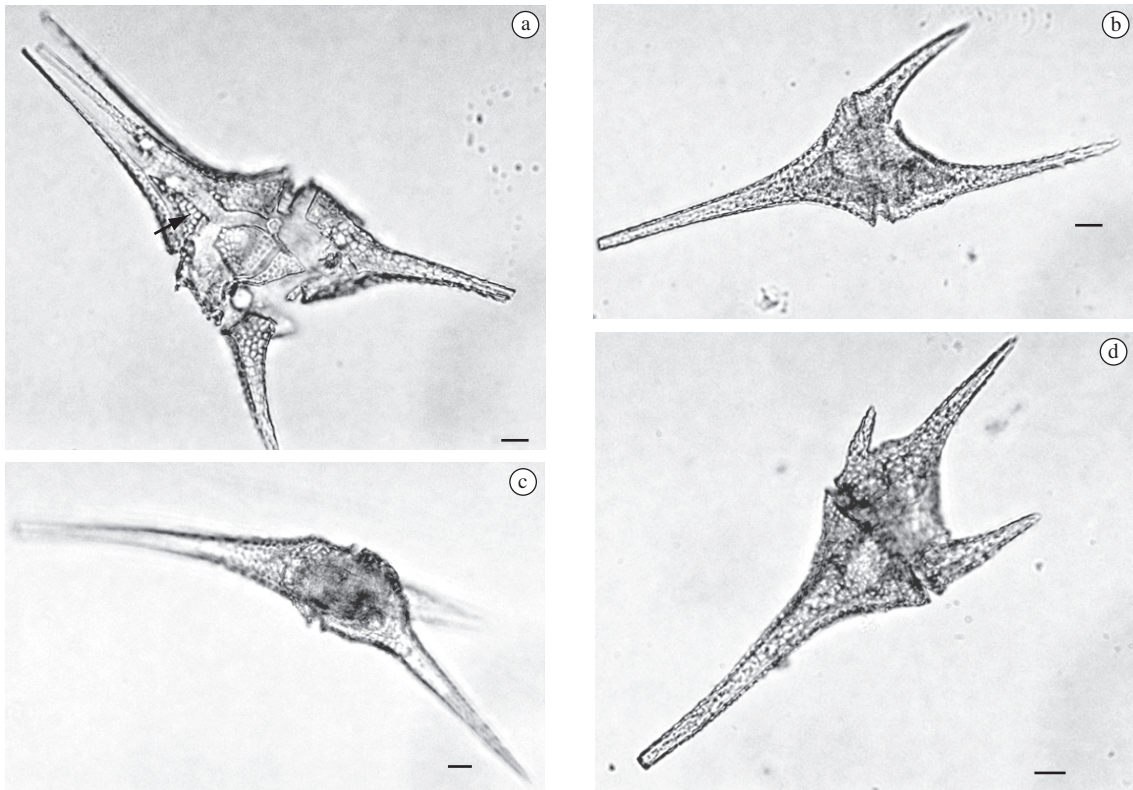


Figure 1. *Ceratium furcoides*: a) Ventral view (with NaClO treatment). Plate 4' (arrow); b) Dorsal view; c) Lateral view; and d) Dorsal view, with the third hipotecal horn. Scale bars = 10 μ m.

served in various water bodies in the Neotropical Region, since 1990 (Mac Donagh et al., 2005). Mac Donagh et al., 2005 believe that the presence of this dinoflagellate in the Neotropical region could be a regional phenomenon associated with specific dispersal mechanisms and local conditions that favor its growth.

Blooms of *Ceratium hirundinella* and the exotic and invasive mollusk *Limnoperma fortunei* were observed in the reservoir Rio Tercero in Cordoba, Argentina, in 1999 (Claps and Ardohain, 2007). This multiple-use reservoir has been undergoing eutrophication since the last decade and is already becoming mesotrophic.

According to Starmach (1974), Padisak (1985) and Bucka and Zurek (1994), *C. hirundinella* is an indicator of clean water, as it avoids water rich in organic compounds. Although this species has previously been associated with environments of low trophic degree, after 1999 it has been recorded in high densities in tropical and subtropical eutrophic water bodies, for example in Argentina (Claps and Ardohain, 2007), South Africa (Hart, 2007) and Australia (Whittington et al, 2000). The occurrence of a bloom of *C. hirundinella* usually results in changes in composition and density of zooplankton communities and also a fall in chlorophyll a concentration (Claps and Ardohain, 2007).

In the present study, zooplankton densities in the Furnas Power Plant Reservoir were lower in the locali-

ties where *C. furcoides* was found. Further studies will explore the matter in detail.

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