Actinella species (Bacillariophyta) from an Amazon black water floodplain lake (Amazonas – Brazil)

Sérgio MELO¹, Lezilda Carvalho TORGAN², Stela Valenti RAUPP³

ABSTRACT
The genus Actinella Lewis was studied using planktonic samples from a black water floodplain lake in Central Amazon region. For species identification the taxa were morphological and morphometrically analyzed on base in light microscope (LM) and scanning electronic microscope (SEM). Five species were registered: Actinella brasiliensis Grunow, A. guianensis Grunow, A. gracile Kociolek, A. mirabilis (Eulenstein ex Grunow) Grunow and A. robusta Hustedt. A. gracile is reported for the first time for Amazon State and black water systems and it is firstly documented with SEM. In addition, a review of geographic distribution of Actinella species in Brazilian Amazon region is given.

KEYWORDS: Actinella, diatoms; Amazon, black water, floodplain lakes

Espécies de Actinella (Bacillariophyta) de um lago de inundação amazônico de águas pretas (Amazonas – Brasil)

RESUMO
O gênero Actinella Lewis foi estudado a partir de amostras coletadas em um lago de inundação de águas pretas na Amazônia Central. Para a identificação das espécies as características morfológicas e morfométricas dos táxons foram analisadas em microscopia óptica (MO) e eletrônica de varredura (MEV). Cinco espécies foram identificadas: Actinella brasiliensis Grunow, A. guianensis Grunow, A. gracile Kociolek, A. mirabilis (Eulenstein ex Grunow) Grunow e A. robusta Hustedt. A. gracile é referida pela primeira vez para o estado do Amazonas e para ambientes de águas pretas, sendo documentada pela primeira vez em MEV. Em adição, uma revisão sobre a distribuição geográfica das espécies de Actinella na região da Amazônia brasileira é apresentada.

PALAVRAS-CHAVE: Actinella, diatomáceas, lagos de inundação, águas pretas, Amazônia

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INTRODUCTION

Actinella Lewis 1863 belongs to Eunotiaceae, the only family of raphid diatoms with rimoportulae. Due to both the presence of the rimoportulae and the rudimentar raphe, they constitute an intermediate group between the primitive araphids and the more advanced raphe-bearing (Kociolek, 2000; Kociolek and Spaulding, 2003; Novitski and Kociolek, 2005). This genus presents cells solitary or clustered, the frustules forming star-shaped colonies by the attachment of the smaller ends of the frustules (Patrick and Reimer, 1966). In valve view the valves are slightly curved, expanded at one end (headpole) with short spines on the margins of the valve, attached to solid substrata by the narrow end (footpole).

Actinella species are mainly found, in tropical region (Round et al., 1990) and the main centers of diversity are tropical South America and Africa (Sabbe et al., 2001). Actually, Actinella genus comprises around 60 species, from which around 50% of them were described in the last ten years: two species from Madagascar, twenty three from South America and six from the Australasian region (Kociolek et al., 1997; 2001; Metzeltin and Lange Bertalot, 1998; 2002; 2007; Sabbe et al., 2001). In addition A. punctata var. australis Mangui was moved to A. australis according to Kociolek et al. (1997) and some Eunotia species were recently transferred to Actinella genus by Metzeltin and Lange Bertalot (2007).

In Amazon State, two Actinella species were described, recently: A. disjuncta Metzeltin and Lange-Bertalot and A. rionegrenses Metzeltin and Lange-Bertalot, found in Calado lake and Negro River, respectively. In the Negro River basin, ten Actinella species were registered in the literature: A. pararobusta Metzeltin et Lange-Bertalot, A. pseudohantzschiana Metzeltin and Lange-Bertalot, A. brasiliensis; A. curvatula Kociolek, A. gessneri Hustedt, A. guianensis, A. mirabilis, A. punctata Lewis, A. rionegrenses, A. robusta Hustedt, A. sioli Hustedt e A. tasmaniensis Hustedt (Uherkovich and Rai, 1979; Uherkovich and Franken, 1980; Furushima and Xavier, 1988; Souza-Mosimann et al., 1997; Putz, 1997; Putz and Junk, 1997; Metzeltin and Lange-Bertalot, 1998; 2007; Díaz-Castro et al., 2003, Melo et al., 2004; 2005, Ferrari et al., 2007).

The aim of this study is to describe Actinella species found in an Amazon black water floodplain lake based on the morphometric and morphologic features in optical and/or scanning electronic microscope. We also offer information about the geographic distribution of Actinella species in Brazilian Amazon region.

MATERIAL AND METHODS

This study was based on samples taken in ten stations in Cutiuaú Lake (Table 1), an floodplain lake located on the right bank of Jaú river, an affluent of the right bank of Negro river. These sites are situated in Jaú National Park in the middle Negro river basin. According to Sioli classification (Sioli, 1984), Cutiuaú lake is a typical black water systems, characterized by low pH and electrical conductivity and high concentrations of humic composts.

A total of 10 samples collected in November 2003 (low water period) were analyzed. The samples were collected by plankton net with mesh size of 25 µm, and fixed with Transeau solution. An aliquot of sample was concentrated and the frustules were cleaned according to the method of Stoch (1970). For analysis in LM the slides were mounted in Naphrax and examined in a Zeiss Axioplan photomicroscope. For SEM analysis the material was mounted on glass on stubs and metalized with gold-palladium and analized in Jeol JSM -5800 operated at 15-20 kV in the Federal University of Rio Grande do Sul.

The identifications of the taxa were based on Hustedt (1930,1952, 1965), Patrick and Reimer (1966), Kramer and Lange-Bertalot (1991), Metzeltin and Lange-Bertalot (1998, 2002, 2007), Kociolek et al. (2001). Classification system and terminology were based on Round et al. (1990). The analyzed material was stored at the Herbarium (INPA) of the Instituto Nacional de Pesquisas da Amazonia, Manaus, Amazonas, Brazil, numbers 222764-222773 (Table 1).

Table 1 - Sampling stations (SS) with geographic coordinates (GC) and Herbarium number (INPA) of samples collected in Cutiuaú Lake, Jaú National Park, Novo Airão, Amazonas, Brazil on 12/XI/2003

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RESULTS AND DISCUSSION

TAXONOMICAL CONSIDERATIONS

Key for Actinella species identification
1. Valves with undulations on both dorsal and ventral margins  
   - *A. mirabilis*
2. Valves without undulations  
   - 3
   3. Headpole and footpole poorly distinct  
      - *A. robusta*
   3. Headpole and footpole clearly distinct from each other  
      - 4
4. Footpole cuneate  
   - *A. guianensis*
4. Footpole rounded  
   - 5
5. Valves narrow, 2.8-4 µm wide  
   - *A. gracile*
5. Valves broader, usually not less than 4 µm wide  
   - *A. brasiliensis*

*Actinella brasiliensis* Grunow in van Heurck, Synopsis des Diatomées de Belgique, Atlas, pl. 35, fig. 19. 1881.  
(Figures 1-2)

Valves heteropolar, clavate, weakly arcuate, margins parallel. Headpole broadly spatulate-rounded. Footpole narrowly rounded. Punctate striae, parallel, continue from the valve mantle. Small spines present on the margin of the mantle in SEM view. Length 48-57 µm; breadth 4.8-5.5 µm; striae 16/ 10 µm; R l/b 10-14.

Studied material: INPA 222765, 222767, 222769, 222771, 222772

(Figures 3-7)

Valves heteropolar, arched, narrow. Ventral margin of the valves concave, dorsal margin convex. Headpole barely swollen. Footpole narrowly rounded. Punctate striae, parallel, continue from the valve mantle, denser and radiate in the headpole. Small spines present on the margin of the mantle and two bigger spines at footpole in SEM view. Length 75-106.6 µm; breadth 2.8-4 µm; striae 16-18/ 10 µm.; R l/b 20.8-25.

Studied material: INPA 222770

(Figures 8-10)

Valves heteropolar, moderately arcuate. Headpole spatulate as cuneate. Footpole cuneate, less breadth than headpole. Spines around the valve mantle and footpole with two big spines on the apices visible externally in SEM view. Punctate striae, parallel, dense in the poles. Length 112-121.4 µm; breadth 6-8.5 µm at the center of the valve; striae 7-13/ 10 µm; R l/b 14-18.

Studied material: INPA 222764, 222765, 222767, 222768, 222770, 222771, 222773

(Figures 11-14)

Valves heteropolar, elongate, slightly heteropolar in valve view and arcuate. Apices pointed. Dorsal and ventral margin undulate. Punctuate striae, parallel, dense, continue from the valve face and radiate towards the apices. SEM: Helictoglossa and rimoportula are visible in internally valve view. Spines are present around the valve mantle and one big spine present on the apice of the valve in externally view. Short raphe curves from mantle onto valve face. Length 420-425 µm; breadth 16-20 µm; striae 9-13/ 10 µm, R l/b 21-26.

Studied material: INPA 222764, 222765, 222767, 222768, 222770, 222771, 222773


Valves heteropolar, elongate, slightly arcuate. Apices obtusely rounded, subcapitate in the dorsal margin. Dorsal margin moderately convex. Ventral margin moderately concave. Punctate striae, parallel, continue from the valve face, dense and radiate towards the terminal apices. Length 127.3-216 µm; breadth 6.1-7.2 µm; breadth in the headpole 6.7-8.3 µm; striae 8-12/10µm; R/l/b: 19-34.

Studied material: INPA 222766, 222768, 222772

**GEOGRAPHIC DISTRIBUTION IN BRAZILIAN AMAZON REGION**

There are few published studies that list or describe *Actinella* species from the Brazilian Amazon region. In addition, they are concentrated in Amazonas and Pará States (Table 2). From 25 registered *Actinella* species in Brazilian Amazon region, 72% were described as new species (Table 2). This elevated number of *Actinella* species in Amazon region has led certain authors to suggest that the Amazon River is a center of diatom diversity (Kociolek *et al.* 2001).

*Actinella* is usually found in extremely acid and humic waters, and most of the species are in semitropical or tropical waters (Patrick and Reimer, 1966; Round *et al.*, 1990) with an elevated occurrence in black water systems: environments characterized by low pH and electrical conductivity and high concentration of humic composts (Sioli, 1984).

This study registers five *Actinella* species in a black water floodplain lake. *A. mirabilis* was most frequent, registered in 70% of analyzed samples, followed by *A. guianensis* and *A. brasiensis*. In fact, these species are the most common species in Brazilian Amazon region (Table 2). On the other hand, *A. gracile* was registered only twice in Pará State and now is documented for first time to Amazon State and black waters systems. In addition it is firstly documented in SEM showing small spines on the margin of the mantle and two bigger spines at footpole.

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LITERATURE CITED


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