The genus *Euastrum* Ehrenberg ex Ralfs (Desmidiaceae) in a subtropical stream adjacent to the Parque Nacional do Iguaçu, Paraná State, Brazil

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**ABSTRACT** - (The genus *Euastrum* Ehrenberg ex Ralfs (Desmidiaceae) in a subtropical stream adjacent to the Parque Nacional do Iguaçu, Paraná State, Brazil). This study aimed to document the species of *Euastrum* (Desmidiaceae) in a subtropical stream adjacent to an important environmental protection area, the Parque Nacional do Iguaçu, in the extreme west of Paraná State, Brazil. For this purpose, monthly samplings of periphytic material associated to *Eleocharis minima* Kunth were performed in the period between August 2012 and July 2013. This taxonomic inventory allowed the identification of 12 taxa at specific and infraespecific level. Eight new occurrences were recorded for Paraná State: *Euastrum attenuatum* var. *splendens*, *E. bidentatum* var. *bidentatum*, *E. cornubiense* var. *cornubiense*, *E. croasdaleae* var. *croasdaleae*, *E. denticulatum* var. *quadrifarium*, *E. didelta* var. *quadriceps*, *E. elegans* var. *elegans* and *E. evolutum* var. *incudiforme*.

**Keywords:** biodiversity, desmids, Freshwater, taxonomy, Zygnematophyceae


**Palavras-chave:** Água doce, biodiversidade, desmídias, taxonomia, Zygnematophyceae

**Introduction**

*Euastrum* Ehrenberg ex Ralfs (1848) comprises a cosmopolitan distribution genus, belonging to the Desmidiaceae (Zygnematophyceae) family. It has isolated cells, about 2 times longer than wide, or about as long as wide, divided in two semicells. The semicells can be divided into 3 lobes, being 2 basal lobes and one polar lobe (or apical lobe). Many species can present lateral lobes among the basal lobes and the polar lobe.

An important characteristic of the genus is the presence of a median apical incision in most of its representatives, which can be deep or shallow, narrow or open, U-shaped or V-shaped. In lateral view the cells are usually oval, rarely elliptic and subretangular, with narrow or acute spines and truncate poles. In apical view the cells are elliptic, oval, or quadratic, mainly with rounded poles, and showing lateral protuberances. The cell wall can be smooth, punctuated or scrobiculated. It occurs one chloroplastid in each semicell, with usually 1 pyrenoid, in some cases, two or several pyrenoids (Prescott *et al.* 1977, Bicudo & Menezes 2006, Franceschini *et al.* 2010).

For the Paraná State, 11 studies have contributed to desmids knowledge, approaching the *Euastrum*...

This study, although in a qualitative character, highlights the importance of the Brazilian phycological flora knowledge. This also emphasizes the need of knowing the taxa biogeography, once known species number is probably much lower than the real number of existent species, since many habitats and regions have not been sampled yet. Besides, the phycological flora knowledge is extremely necessary as a comparative base for ecological studies in continental aquatic environments, as well to propose biodiversity protection and conservation measures. In face of that, this study aimed to document taxonomically the occurrence of the taxa belonging to the *Euastrum* genus in a subtropical stream, adjacent to Parque Nacional do Iguaçu, an important environmental protection area located in the further western of Paraná State, Brazil.

**Material and methods**

The study was conducted at Tenente João Gualberto stream, an important tributary of the lower Iguaçu River hydrographic basin, located in São Miguel do Iguaçu municipality (25°20'S and 54°14'W), further western of Paraná State, Brazil. This stream is situated in an area adjacent to the Parque Nacional do Iguaçu, the first Brazilian Conservation Unit to be instituted as World Natural Heritage Site by UNESCO. This region has a mesothermal-humid subtropical climate, with well-defined summer and winter periods, and rainfalls regularly well distributed all over the year (Alvares et al. 2014). The sampling station (figure 1) is a small watercourse, approximately 3.4 m large between margins, about 20 cm deep. The area presents approximately 2 m of riparian vegetation in its surroundings.

The biological material samplings were performed in the period between August 2012 and July 2013, totalizing 12 months of samplings. The periphytic material was collected from the aquatic macrophyte *Eleocharis minima* Kunth, being removed with the help of a brush and distilled water jets. Samples were preserved in Transeau solution, in the proportion of 1:1, according to Bicudo & Menezes (2006). The biological material is deposited in the State University of West Paraná (UNIOESTE) Herbarium, Cascavel campus (UNOP-Algae).

For the qualitative analysis an average of 15 slides per sample were prepared. The microalgae morphometric and photographic analysis was performed in a trinocular microscope with infinite correction optical, Olympus model CX31, with camera attached. The systematic and taxonomic framework for the identified taxa was performed based on the classic literature of Prescott et al. (1977), as well as in specialized scientific papers.

The measures (in μm) are represented by the symbols: L - length, W- width and I - isthmus, and the morphometric data were recorded for all the taxa. The taxa geographic distribution was obtained in Guiry & Guiry (2016). It was also verified the occurrence of taxa for Paraná State. Comments were elaborated when deemed necessary.

**Results and Discussion**


Artificial key to the identification of *Euastrum* Ehrenberg *ex* Ralfs recorded at the Tenente João Gualberto stream, Paraná, Brazil. Taxa with asterisk are new records:

1. Semicells without apical incision ................................................................. *E. attenuatum var. splendens*
2. Semicells with apical incision
3. Semicells with shallow median apical incision
4. Semicells trapeziform ................................................................. *E. insulare var. insulare*
5. Semicells pyramidal

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4. Semicells pyramidal with one undulation between the apical and basal lobes ........................................
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   \textit{E. croasdaleae} var. \textit{croasdaleae}\* 

4. Semicells pyramidal with two undulations between the apical and basal lobes ........................................
   ...............................................................................................................
   \textit{E. cornubiense} var. \textit{cornubiense}\* 

2. Semicells with deep median apical incision
5. Semicells with closed apical incision
6. Semicells with apex slightly inflated and surrounded by large granules \ldots \ldots \textit{E. didelta} var. \textit{quadriiceps}\* 

6. Semicells with apex truncate and without inflations \ldots \ldots \textit{E. ansatum} var. \textit{ansatum} 

5. Semicells with open apical incision
7. Face of semicell with the presence of granules
8. Cells subrectangular with rounded basal lobes with one undulation \ldots \ldots \textit{E. denticulatum} var. \textit{denticulatum} 

8. Cells rectangular-pyramidal with basal lobes with two undulations \ldots \ldots \textit{E. denticulatum} var. \textit{quadrisarium}\* 

7. Face of semicell with the presence of spines
9. Cells < 30 µm
10. Apical margin angular and with a broad V-shaped invagination \ldots \ldots \textit{E. bidentatum} var. \textit{bidentatum}\* 

10. Apical margin truncate and with a broad U-shaped invagination \ldots \ldots \textit{E. elegans} var. \textit{elegans}\* 

9. Cells >30 µm
11. Apical margin with a prominent upwardly directed spine \ldots \ldots \textit{E. evolutum} var. \textit{evolutum} 

11. Apical margin with a prominent spine extended to the angles \ldots \ldots \textit{E. evolutum} var. \textit{incudiforme}\* 

\textbf{Figure 1.} Location of the sampling station in the Tenente João Gualberto Stream, Parque Nacional do Iguacu, Paraná State, Brazil.

\textit{Euastrum ansatum} Ehrenb. ex Ralfs var. \textit{ansatum}, 
Brit. Desmid.: 85, pl. 14, fig. 2a-f. 1848.
Figures 2-3

Cells longer than wide. L: 61.6-94.7 µm; W: 25.0-46.6 µm; I: 9-13.3 µm. Semicell pyramidal-truncate, 3-lobed, deep median constriction, median sinus closed, truncate apical margin, rounded angles, lateral margins concave at the basal lobes and parallel at the apical lobe, rounded basal angles. Apical and lateral view not observed. Cell wall punctate. Chloroplastid with one pyrenoid per semicell.

Material examined: BRAZIL. \textsc{Paraná}: São Miguel do Iguacu, Tenente João Gualberto Stream, 29-X-2012, \textsc{L.C. Servat} (UNOP-Algae3962).


\textit{Euastrum attenuatum} var. \textit{splendens} (Fritsch & Rich) 
Figures 4-6
Cells longer than wide. L: 50-52.5 µm; W: 29.0-33 µm; I: 6-9.9 µm. Deep median constriction, sinus open, semicell subquadrate, without median incision, with a protrusion surrounded by large granules, concave margins forming a polar lobe with subparallel margins, the apex slightly inflated. Face of the semicell with a median inflation surrounded by large granules and with a large inflation on both sides of the basal lobes. Lateral view elliptic. Apical view not observed. Cell wall smooth. Chloroplastid with two pyrenoids per semicell.


Occurrence in the Paraná State: First record of the taxon.

According to Prescott et al. (1977) the variety splendens (Fritsch & Rich) Grönbland & Scott differs from the typical variety by having the basal lobes broadly extended and rounded, from a broadly open sinus. The individuals found showed smaller size when compared to the ones cited Prescott et al. (1977), which the length would be 61-66 µm; width 39 µm and isthmus of 11-12 µm.

**Euastrum bidentatum** Nägeli, 1849, Gatt. Algen. p.122. pl. 7-D: figs 1a-f var. **bidentatum**

Cells longer than wide. L: 20.5-26.2 µm; W: 13.2-17.3 µm; I: 3.3-4 µm. Deep median constriction, sinus almost closed, semi-elliptical semicell with rounded poles and with undulate margins, apical margin angular and with a wide incision V-shaped, ornamented with spiniferous processes at the terminal angles. Face of the semicell with a median protrusion ornamented with several granules. Apical and lateral view not observed. Cell wall smooth. Chloroplastid with one pyrenoid per semicell.


Occurrence in the Paraná State: First record of the taxon.

**Euastrum croasdaleae** Grönbland var. **croasdaleae**


Occurrence in the Paraná State: First record of the taxon.

Occurrence in the Paraná State: First record of the taxon.

Euastrum denticulatum (Kirchner) Gay var. denticulatum, Bull. Soc. Bot. Fr. 31: 335. 1884.

Figures 12-13

Cells longer than wide. L: 13.3-24.6 µm; W: 10.5-18.4 µm; I: 2.9-5.7 µm. Deep median constriction, sinus closed, semicell subtrapeziform, basal lobes rectangular, lateral margins undulated, notch between the basal and apical lobes open and shallow, apical lobe with deep median notch, short spine at each of the angles. Apical view elliptic with a protuberance. Lateral view not observed. Cell wall ornamented with granules. Chloroplastid with one pyrenoid per semicell.


Occurrence in the Paraná State: First record of the taxon.


Figure 14

Cells longer than wide. L: 20.6 µm; W: 16.8 µm; I: 5.1 µm. Deep median constriction, linear sinus closed, semicell subtretangular with subparallel lateral margins, apical margin truncate with a small incision V-shaped. Face of the semicell with four large granules arranged in a circle, with two mucilage pores on either side and above the midregion. Apical and lateral view not observed. Cell wall punctate. Chloroplastid with one pyrenoid per semicell.


Occurrence in the Paraná State: First record of the taxon.

E. denticulatum var. quadrifarium differs from the typical variety by having its polar lobe more prominent, besides showing four granules arranged in circle, with two mucilage pores on either side and above the midregion (Prescott et al. 1977).


Figures 15-17

Cells longer than wide. L: 93.6-96.8 µm; W: 47.8-48.1 µm; I: 10.4-13.2 µm. Deep median constriction, sinus narrow and closed, semicell pyramidal with rounded lateral margin and apical margin truncate, 3-lobed. Face of the semicell with two protrusions immediately below the polar lobe and with three tubercular swellings immediately above the isthmus. Apical and lateral view not observed. Cell wall grossly punctate. Central Chloroplastid. Pyrenoids not observed.


Occurrence in the Paraná State: First record of the taxon.

E. didelta var. quadriceps differs from the typical variety by presenting three protrusions well-marked immediately below the isthmus and by showing cell wall grossly punctate (Silva & Felisberto 2015). The individuals found showed inferior size than the ones cited by Prescott et al. (1977), which the length would be 114-132 µm; width 51-66 µm and isthmus of 15-22 µm, although all the other characteristics are in accordance with the description.

Euastrum elegans (Bréb.) Kütz. ex Ralfs var. elegans, Brit. Desmid.: 89, pl. 14, fig. 7a-c. 1848.

Figure 18-19

Cells longer than wide. L: 18.3-20.8 µm; W: 12.8-15.5 µm; I: 3.3-3.6 µm. Deep median constriction, sinus narrow and closed. Semicell subtretangular, lateral margins bilobed and retuse ending in a subapical spine, apical margin of the polar lobe elevated with a deep median incision, face of the
Aquino et al.: *Euastrum* in a subtropical stream

semicell with two tubercles in the midregion. Apical and lateral view not observed. Chloroplastid with one pyrenoid per semicell.


Occurrence in the Paraná State: First record of the taxon.

The individuals found presented inferior sized than the ones cited by Prescott et al. (1977), which the length would be 26.6-39 μm; width 14-30 μm and isthmus of 4-8 μm, although all the other characteristics are in accordance with the description.


Figures 20-23

Cells longer than wide. L: 42.8-55.6 μm; W: 30-40.4 μm; I: 8-8.9 μm. Deep median constriction, median sinus linear, closed, cells subrectangular in outline, semicell approximately trapeziform, with one median protrusion ornamented with 3 granules disposed in circle, apex truncate, median apical incision V-shaped or U-shaped. Lateral view oval, with narrow and acute spines. Apical view not observed. Chloroplastid with one pyrenoid per semicell.


Occurrence in the Paraná State: First record of the taxon.

According to Prescott et al. (1977) E. evolutum var. incudiforme (Börges) West & West differs from the typical variety by presenting smaller measures, two minute teeth on either side of the median incision and by not having intramarginal granules in the polar lobes. The individuals found presented inferior size than the ones cited by Prescott et al. (1977), which the length would be 50-60 μm; width 36-39 μm and isthmus of 7.5-10 μm, although all the other characteristics are in accordance with the description.

Euastrum insulare (Wittrock) Roy var. insulare, Monogr. Scott. Nat. p. 68, fig. 4A. 1883.

Figures 26


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