

A new Patagonian *Cosmarium* species motivating distinction of a separate biogeographical desmid region

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Abstract

Cosmarium valerioense is newly described from Laguna Valerio, situated on the Patagonian highland plateau Somuncurá. It is marked by a highly inflated semicell centre resulting in a remarkably quadrilobed apical cell view. In this feature it corresponds to some other *Cosmarium* species recently described from this climatically harsh part of the world. One of those species, viz. *Cosmarium chapuense*, was also encountered in Laguna Valerio showing a rather high degree of morphological variability.

The exclusive phenomenon of such 'quadrilobate' *Cosmarium* species may give rise to distinguish a separate biogeographical region within the South American continent.

keywords: desmids, new species, *Cosmarium*, Somuncurá Plateau, Patagonia

Introduction

The Somuncurá (or Somún curá) plateau in Río Negro Province of northern extra-Andean Patagonia, Argentina, is a Natural Protected Area due to its

importance from ecological, climatic, archaeological, anthropological and geomorphological point of view (PMANPMS, 2007). Geomorphological and biogeographical characteristics correspond to a flat, steppe-like landscape at 1200-1400 m asl. resulting in a very peculiar, isolated environment with a high biodiversity and many endemic forms (Cei, 1969; Muzón et al., 2005). However, endemism and even microendemism are mainly described for fauna elements (e.g., Miquel 1998; Ortubay, 1998; Breitman et al., 2015; Velasco et al., 2016; De Lucía & Gutiérrez Gregoric, 2017). For various components of the Somuncurá plateau biota a relict character has been suggested (Ringuelet, 1961, Menni & Gomez, 1995). Yet, this region has been but relatively little researched due to its isolated, hardly accessible nature with only a few human settlements. Moreover, some of the few roads that cross the plateau have been abandoned for several decades. Surprisingly, limnological studies in a number of shallow water bodies carried out by the first author revealed the occurrence of a number of interesting desmid species, two of which that were confined to Laguna Valerio are dealt with in the present paper.

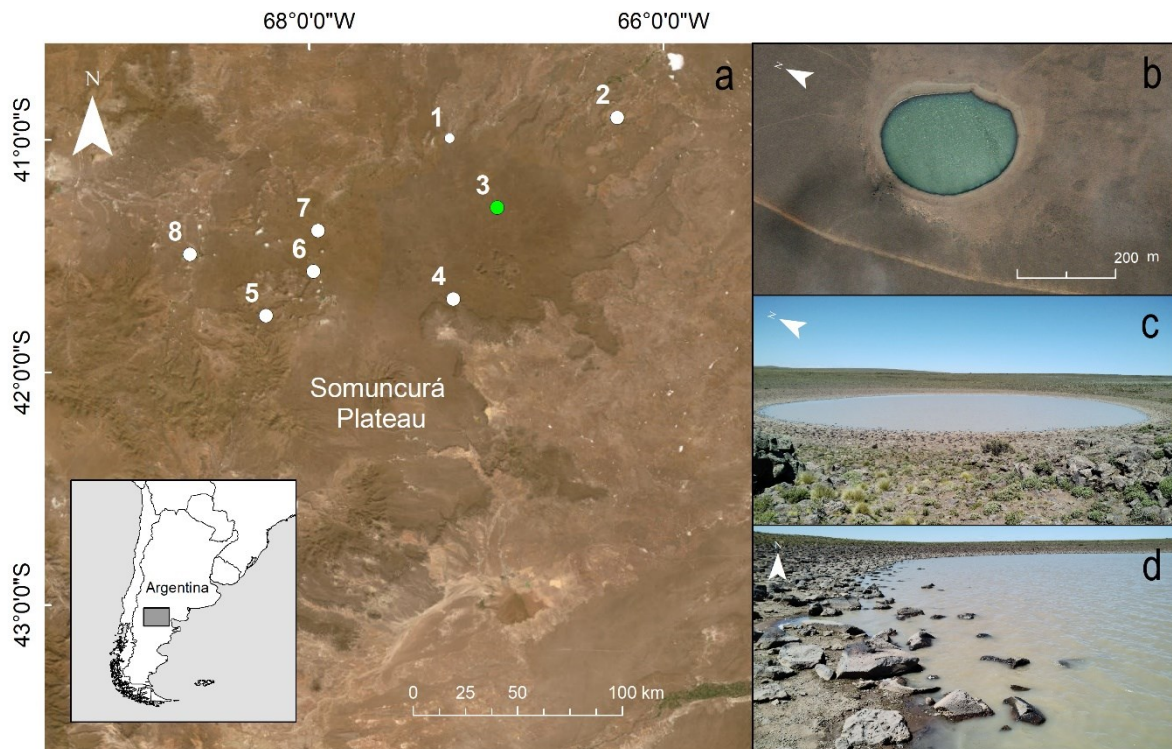


Figure 1. Map of Somuncurá Plateau with location (nr. 3) of Laguna Valerio. Next to that, pictures of the proper lake and the collection site. Figure 1a, b from QGIS Geographic Information System. Figure c, d © Yeny Labaut.

Study area

Laguna Valerio is a temporary, shallow lake of some 200-300 m in diameter located in the volcanic area of Somuncurá Plateau (fig. 1). The zone is associated with basaltic lava flows extending over a distance of 15 to 20 km surrounding older volcanic constructions (Remesal et al., 2019). Summer temperatures usually are within the range of 10-16° C but low outliers to 4° C and high ones to 35° C are far from rare. Winter temperatures drop to -25° C. The rainfall regime rarely exceeds 100-150 mm per year and in summer months the lake may fall dry completely. The lake is destitute of any vascular aquatics, charophytes being the main macrophytes (figs 1c, 1d).

Sampling and analyses

Samples were collected in November 2022 from the margin zone of the lake between 5 and 30 cm below the surface. Conductivity and pH were measured *in situ* with an OAKTON PCS Testr 35 multiparameter tester. Benthos was collected by scraping off submerged stones with a toothbrush. All samples were fixed with formaldehyde to a final concentration of 4% and observed with a Zeiss Axio Imager.2M at 400x magnification and Axio 105. Scanning electron microscopy procedure was mainly according to Mann et al. (2007). Those authors recommended sonication for 5-45 s in HCl (1N) to remove mucilage and obtain cleaner cells but we placed subsamples in HCl (1N) during 3 weeks. As the combination of formaldehyde (fixation) and HCl may lead to formation of bis(chloromethyl) ether, a potential powerful carcinogen (Mann et al., 2007), the subsamples were previously washed in distilled water.

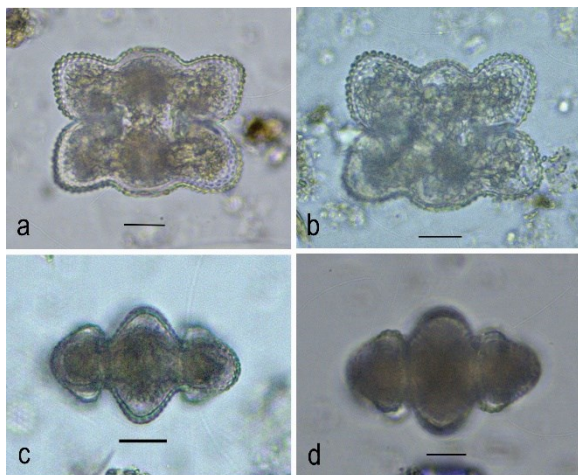


Figure 2. Morphological variation in *C. chapuense* from Laguna Valerio in frontal view (a, b) and apical view (c, d, in proximal and median focus, respectively). Scale bar = 20 µm. Photo © Yeny Labaut.

Results

At the time of sampling, maximum depth of Laguna Valerio was about one meter. Conductivity was 215 µm.cm⁻¹ and pH was 7.4. Benthos samples were predominated by filamentous green algae, mainly *Oedogonium* sp. and pennate diatoms of the genera *Cymbella*, *Navicula* and *Eunotia*. Also, a small number of desmid species were encountered confined to the genera *Closterium* and *Cosmarium*. Among more or less cosmopolitan species such as *Closterium venus*, *Cl. acerosum*, *Cl. pseudolunula*, *Cosmarium laeve* and *C. subspeciosum*, two relatively large *Cosmarium* species drew the attention because of their peculiar cell morphology, viz. with a strikingly inflated central part of the semicells, in apical view sharply separated from the lateral semicell lobes. Those two species are discussed below.

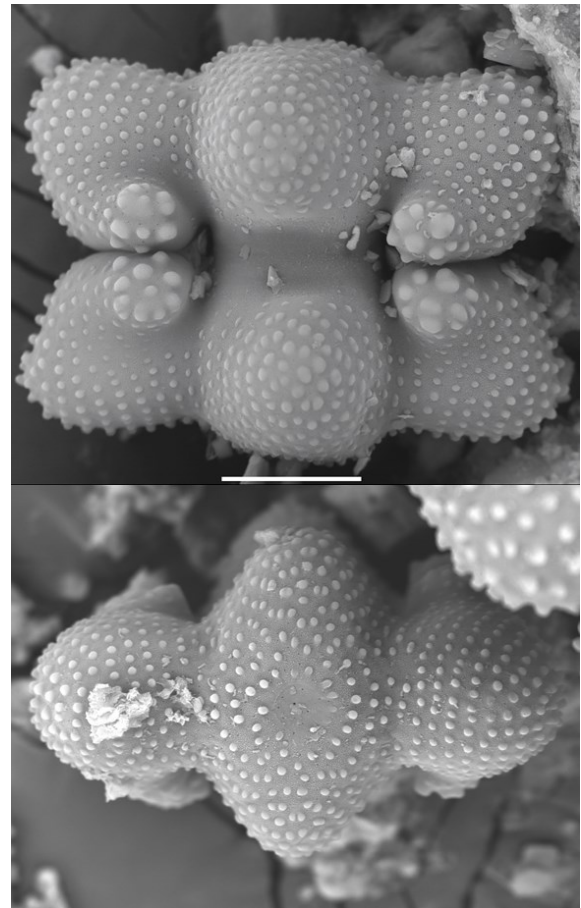


Figure 3. SEM photos of *C. chapuense* (in frontal and apical view) from Laguna Valerio. Scale bar = 20 µm. Photo © Yeny Labaut.

Taxonomy

Cosmarium chapuense

figs 2-3

This species was described by Coesel et al. (2017) from Lake Chapu (Laguna el Chapu), a shallow Patagonian lake similar to Laguna Valerio but situated in a more southern part of the country. The

alga collected from Laguna Valerio depicted in our fig. 2 obviously belongs to the same species albeit that the lateral semicell lobes tend to be more raised than those in the Laguna el Chapu material. In view of the variability of this feature both in the Valerio and the Chapu samples we desist from describing the Valerio specimens as a separate variety. A remarkable detail of cell wall sculpturing overlooked in the original description of this species but revealed in our SEM pictures concerns shape and granulation of the basal part of the lateral lobes just near the isthmus, namely inflated and covered with distinctly larger granules than elsewhere on the lobes (fig. 3). The diagnosis of *C. chapuense* in Coesel et al. (2017: 91) does not mention this characteristic but some of it could be perceived in a corresponding drawing (Coesel et al., 2017, fig. 6). In Laguna Valerio benthos, *C. chapuense* turned out to be a predominant species, being present with many specimens in each microscope slide. As compared with the material from Laguna el Chapu, cells in Laguna Valerio had somewhat larger dimensions: up to 76 µm in length and up to 90 µm in breadth (versus 67 µm and 77 µm, respectively, in the Chapu material).



Figure 4. *C. valerioense* in frontal view. Scale bar = 50 µm. Photo © Yeny Labaut.



Figure 5. *C. valerioense* in oblique frontal view showing basal inflation of the semicells. Scale bar = 50 µm. Photo © Yeny Labaut.



Figure 6. *C. valerioense* in apical view. Scale bar = 50 µm. Photo © Yeny Labaut.



Figure 7. *C. valerioense* in lateral view. Scale bar = 50 µm. Photo © Yeny Labaut.

***Cosmarium valerioense* Coesel et Labaut sp. nov.
figs 4-9, 10d**

Diagnosis: Cells biradiate, in frontal view about as long as broad with a deep median constriction. Sinus widely open at its apex and its exterior, closed half-way. Semicells low-pyramidal in outline with a truncate apex, straight to slightly concave lateral sides and broadly rounded basal angles. Just above the isthmus a big inflation. Semicells in apical view 4-lobed, the lateral lobes distinctly larger than the median lobes. Semicells in lateral view about pyramidal in outline with a very broadly rounded apex, deeply concave sides and broadly rounded basal angles. Cell wall for the most part covered with granules arranged in concentric circles around the angles. Cell dimensions: length 143-189 µm, breadth 143-189 µm, thickness 120-134 µm.

Type: Argentina, Patagonia, Río Negro Province: Laguna Valerio, 41°16'29.7" S, 66°54'54.0" W; Labaut, 20 November 2022. Holotype: LPC 16653, "Dr. Sebastián A. Guarrera" Phycology Division Herbarium, Museum of La Plata, National University of La Plata, partly illustrated in our figs 4-9.

Differential diagnosis: *C. valerioense* should be compared with *C. quadrilobatum* Thérézien et Couté (1977: 67-68, pl. 16: 7) described from the sub-Antarctic Kerguelen Islands, see our fig. 10 c. At first

glance the two species much agree but on closer examination there are a number of essential differences. In frontal view, semicells of *C. quadrilobatum* are a bit reniform and marked by a slightly protracted apex, features missing in *C. valerioëense*. In lateral view, highest breadth of semicells in *C. quadrilobatum* is about half-way versus at the base in *C. valerioëense*. In apical view, highest breadth of lateral lobes in *C. quadrilobatum* is about half-way versus at the base in *C. valerioëense*. Finally, cell dimensions in *C. quadrilobatum* (60-64 x 56-62 µm) are less than half of those in *C. valerioëense*.

In Laguna Valerio benthos, *C. valerioëense* was less abundant than *C. chapuense*. Nevertheless, in each microscope slide it could be encountered with a number of cells.

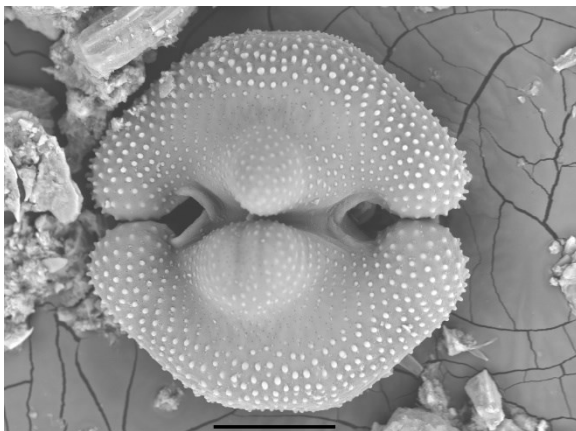


Figure 8. SEM photo of *C. valerioëense* in frontal view. Scale bar = 50 µm. Photo © Yeny Labaut.

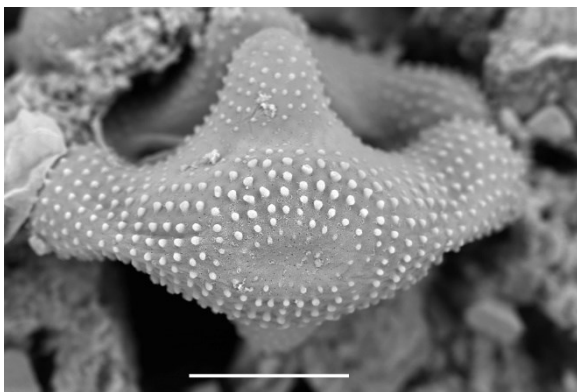


Figure 9. SEM photo of *C. valerioëense* in oblique apical view. Scale bar = 50 µm. Photo © Yeny Labaut.

Biogeography

Whereas the rich desmid flora of the tropical part of South America is characterized by quite a number of conspicuous, endemic species, from the cool-temperate lakes in northwestern Patagonia mainly species with a cosmopolitan distribution were known. Consequently, this geographical region seemed to be destitute of an own characteristic set

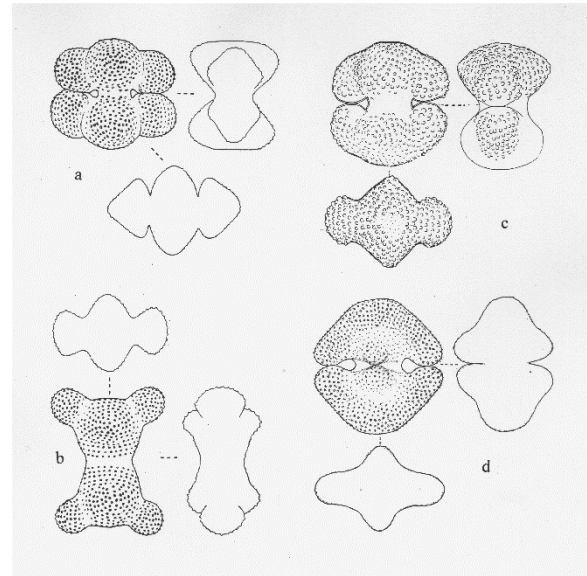


Figure 10. Collage of four quadrilobate *Cosmarium* species. a: *C. chapuense*, b: *C. mickeyoides*, c: *C. quadrilobatum*, d: *C. valerioëense*. a and b after Coesel et al. (2017), c after Thérézien & Couté (1977), d original.

of species (Coesel, 1996). However, most of the data in question were provided by Thomasson (1963) who studied a large number of deep, glacial lakes (some of them in combination with lake-side pools and ponds). In Patagonia there is a strong west-east precipitation gradient between the Andes and the Atlantic slope which causes an annual precipitation of more than 2000 mm near the Andes, whilst less than 200 mm is recorded in the extreme east (Paruelo et al., 1998; Ramos et al., 2022). The lakes studied by Thomasson (1963) are located in the western (Andean) zone of humid temperate forest, so essentially differing from the shallow, volcanic depression in the arid Patagonian steppe, subject of our present study. When comparing the desmid flora of Laguna Valerio with that of the similarly created Laguna el Chapu there is a striking occurrence of morphologically quadrilobate *Cosmarium* species: *C. chapuense* in both lagunas, *C. mickeyoides* in Laguna el Chapu, *C. valerioëense* in Laguna Valerio (fig. 10). Such-shaped *Cosmarium* species with an extremely inflated semicell centre are unknown from the rest of the world except *C. quadrilobatum* described from the subantarctic Kerguelen Islands (fig. 10). That latter location, situated in the southern Indian Ocean represents a similar desolate, volcanic region as faced in the steppe of the arid part of Patagonia. The desmidiological link between Patagonia and the Antarctic zone is supported by the presence of another remarkably shaped *Cosmarium* species, namely *C. decussare* Brook et Williamson (1983) described from the Antarctic Signy Island, but also encountered in Laguna el Chapu (Coesel et al., 2017).



So, considering biogeography of desmids in South America there seems to be good reason to distinguish a separate Patagonian district characterized by shallow, periodical lakes, volcanic substrates and very harsh climatic conditions. The region in question, marked by the occurrence of so-called quadrilobate *Cosmarium* species shows connections with Antarctic desmid flora elements.

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