

Cymbellonitzschia chilena sp. nov. (Bacillariophyta), a new diatom species from Laguna La Punta, Salar de Atacama, Chilean Altiplano

Cymbellonitzschia chilena sp. nov. (Bacillariophyta), una nueva especie de diatomea recolectada en Laguna La Punta, Salar de Atacama, Altiplano Chileno

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RESUMEN

Se describe a *Cymbellonitzschia chilena* como una especie nueva de diatomea. El taxón se caracteriza por poseer valvas angostas, arqueadas, con el lado dorsal fuertemente convexo, el ventral cóncavo a sub-linear, con extremos delgados, rostrado-redondeados. Eje apical 20.2-35.0 μm . Canal del rafe marginal, rafe continuo, ubicado en el lado dorsal o ventral de la valva. Estrías paralelas, 20-24 en 10 μm . En vista conectival el frústulo es rectangular, curvado. Se señalan las diferencias existentes con las restantes especies del género.

Palabras claves: diatomea, morfología, nueva especie.

ABSTRACT

Cymbellonitzschia chilena is described as a new species of diatom. The taxon is characterized by its narrow, arched valves, with a highly convex dorsal side, a concave to sub-linear ventral side, and thin, rostrate-rounded ends. The apical axis measures 20.2–35.0 μm . The marginal raphe canal is continuous, located on either the dorsal or ventral side of the valve. Striae are parallel, with 20-24 in 10 μm . In connective view, the frustule is rectangular and curved. Differences from other species in the genus are also highlighted.

Keywords: diatom, morphology, new species.

The genus *Cymbellonitzschia* was established by Hustedt in 1924 to include pennate diatoms with affinity to the genus *Cymbella* Agardh by its asymmetry across the apical plane (dorsiventral valve outline) and, to the genus *Nitzschia* Hassall, principally by having a bacillarioid canal raphe system and a similar chloroplast arrangement (Round *et al.* 1990). Seven species are known: *C. minima* Hustedt (1924), *C. diluviana* Hustedt (1950 and 1954), *C. cataractorum* Kufferath (1957) and *C. manguini* Maillard (1967) from freshwater environments, and *C. hossamedini* Salah (1955), *C. szulczewskii* Witkowski *et al.* (2000) and *C. banzuensis* Stepanek *et al.* (2016) from marine coastal waters. The investigation on some of these

species, lacking the modern techniques of microscopy, only offer line drawings to illustrate a few morphological features (Salah 1955, Kufferath 1957, Maillard 1967), making difficult the comparison with the other taxa included in the genus.

Continuing our contribution to the knowledge on the diatom flora from the Chilean Altiplano (Rivera & Cruces 2009a, 2009b, 2015, 2018; Rivera *et al.* 2019), we here describe *Cymbellonitzschia chilena* sp. nov., from material collected in Laguna La Punta, Salar de Atacama, Chile. The new species is characterized by (a) elongated and arcuated valves; (b) rostrate ends; (c) strongly convex dorsal and concave to linear ventral margins; (d) by a very thin and

continuous raphe, either on the dorsal or the ventral margins, and (e) by the frustules curved (bow-like) in girdle view.

The Chilean altiplano harbors numerous of unique species (e.g., Dorador *et al.* 2013, Vila *et al.* 2013, Watson *et al.* 2013, Collado 2015). In recent years numerous studies have been carried out to analyze the fauna and vascular flora of these region's watersheds (Jara-Arancio 2010, Ardiles & Fariña 2014, Gatica-Castro *et al.* 2015). However, compared to the country's central zone, the diversity of diatoms in this area has still been poorly studied (Rivera 2006).

The type locality (23° 43'29" S; 68° 14'25" W), Laguna La Punta, is a pristine lake located 2,305 m a.s.l. at the southern end of the Salar de Atacama in the Antofagasta Region, Chile (Ramos-Tapia *et al.* 2023). It is a shallow and salt-water lake (Núñez *et al.* 2020), with permanent evaporation that generate physicochemical changes that influence the composition of the microbial community (Ramos-Tapia *et al.* 2023). According to this author, the mean value of some physicochemical parameters for Laguna La Punta are the: pH = 8.21; salinity (g/L) = 26.34; total silica (mg/L) =112.88; nitrate (mg/L) = 0.5667; phosphates (mg/L) =0.09; total alkalinity CaCO³ (mg/L) = 404.35.

The sample analyzed was send to us, free of organic matter, by the Center of Applied Ecology S.A. (CEA), Santiago, Chile. Diatom slides were prepared following Hasle & Fryxell

method (1970) and deposited at the Diatom Collection of the University of Concepcion, Chile. More than ninety frustules, principally isolated valves, were observed and analyzed by light (LM) and electron microscopy (SEM and TEM). LM observations were performed with a Zeiss Photomicroscope III. The valve ultrastructure was examined by means of a JEOL JSM-6380LV and a JEOL 1200 Ex II scanning and transmission electron microscope respectively (Spectroscopy and Electron Microscopy Center, University of Concepción, Chile). Also, a scanning electron microscope TESCAN VEGA 3, model SBU EASY PROBE was used (CMA-BIO.BIO, University of Concepción, Chile).

Cymbellonitzschia chilena Rivera, P., Cruces F. & Ascencio, E., sp. nov. (Figs. 1-2)

Holotype: Slide DIAT-CONC 7811, deposited at the Diatom Collection Universidad de Concepción, Department of Botany, Concepción, Chile.

Isotype: Slide DIAT-CONC 7812, Diatom Collection Universidad de Concepción.

Type locality: 23° 43'29" S, 68° 14'25" W, periphyton, Laguna La Punta, in the southern portion of the Salar de Atacama. II Region Antofagasta. Material collected 21.VII.2023.

Etymology: The species epithet refers to the country where the material was collected (Chile).

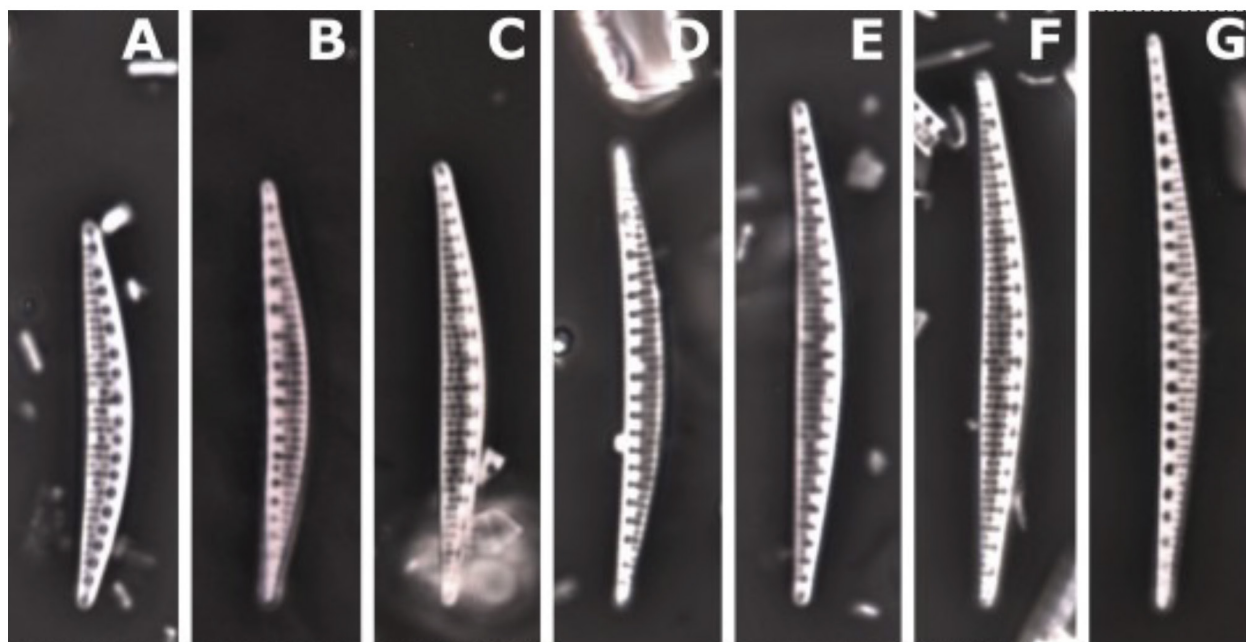


FIGURE 1. *Cymbellonitzschia chilena* sp. nov. Light Microscopy. A, C, E, F. Canal-raphe on the dorsal valve margin. B, D, G. Canal-raphe on the ventral valve margin. Scale bar A-G = 10 μ m. / *Cymbellonitzschia chilena* sp. nov. Microscopía Fotónica. A, C, E, F. Canal del rafe en el margen dorsal de las valvas. B, D, G. Canal del rafe en el margen ventral de las valvas. Escalas: A-G = 10 μ m.

In valve view, the valves are elongated and arcuated, narrow, with the dorsal margin strongly convex, and the ventral margin concave to sub-linear (Fig. 1A-1G). Valves are 20.2-35.0 μm long and 2.0-2.6 μm wide, with protracted, narrow, round-rostrate apices (Fig. 2A-2G). The canal-raphe is eccentric, at the junction of the valve face with the mantle (Fig. 2C, 2F) on the dorsal (Fig. 1A, 1C, 1E-F, Fig. 2C-2E) or ventral valve margins (Fig. 1B, 1D, 1G, Fig. 2A-2B). In LM the fibulae and the striae are visible. Fibulae 9-13 in 10 μm , the central pair not widely spaced than the others (Fig. 1A-1G, Fig. 2D-2E). Striae parallel throughout, 20-24 in 10 μm (Fig. 1A-1G, Fig. 2A-2E).

SEM observations revealed that externally the raphe is a very thin and continuous slit (Fig. 2H), with the terminal fissures always curved to the dorsal margin (Fig. 2B-2C, 2F); a keel is not present. Internally there is a helictoglossa (Fig. 2G). Each fibula is connected to 1-3 interstriae (Fig. 2D-2E). The striae are uniseriate, with round or elongated areolae (Fig. 2A-2E). However, some of the valve's face striae terminate close to the raphe in two areolae linked with each other, smaller than those of the uniseriate striae (Fig. 2H, arrow). The same occurs in the valve mantle (Fig. 2F, arrow), basically structured with only one longitudinal row of elongated areolae, parallel to the raphe, 21-24 in 10 μm (Fig. 2H). Externally the areolae are occluded by very delicate hymens (Fig. 2J). In girdle view the frustules are curved like a bow (Fig. 2I). Bands of the cingulum were not observed.

In Laguna La Punta, Salar de Atacama, *Cymbellonitzschia chilena* sp. nov. was common in the sample, which was dominated by species of the genera *Denticula* Kützing and *Nitzschia* Hassall. In addition to the type locality, *Cymbellonitzschia chilena* sp. nov. has been reported as *Cymbellonitzschia* sp. from Salar de Punta Negra and Salar de Atacama (Díaz & Maidana 2005, as *Cymbellonitzschia* Hustedt sp. 1, p. 59) and cited from Salar de Ascotán and Salar Carcote (Heine-Fuster *et al.* 2021).

The principal morphological features of the Chilean material agree well with those described for the genus *Cymbellonitzschia* Hustedt: valves asymmetrical to the apical axis with dorsiventral valve outline, the canal raphe on the dorsal or ventral margin (Kociolek *et al.* 2015; Stepanek

et al. 2016). However, *Cymbellonitzschia chilena* can be distinguished from all previously described species (valves smoothly arched dorsal margin and ventral straight margin; frustules linear- rectangular in girdle view) by the elongated and narrow shape of the valve with protracted and narrow round-rostrate apices, strongly arched dorsal margin (raphe in 55.8 % of the valves) and concave to sub-linear ventral margin (raphe in 44.2 % of the valves) and by the frustule curved like a bow in girdle view. According to Stepanek *et al.* (2016), the marine described species of the genus (*C. szulczewskii* Witkowski 2000, and *C. banzuensis* Stepanek *et al.* 2016, present the external terminal fissures of the raphe curved to the dorsal margin, like those of *Cymbellonitzschia chilena*, but they differ from the Chilean specie by having a discontinuous raphe (with central fissures). Also, in *C. szulczewskii* the striae are denser (> 28 in 10 μm).

Carballeira *et al.* (2017) described *Nitzschia varelae* from brackish coastal wetlands on the Atlantic and Mediterranean coasts of the Iberian Peninsula. This species present arcuate valves with long and narrow rostrate apices, raphe on the same side of the frustule. Although the molecular data indicated that the species does not belong to the same lineage as the type species of *Nitzschia*, authors assigned the species to this genus, until the generic limits in the Bacillariaceae are better understood. *Nitzschia varelae* has a general resemblance with *Cymbellonitzschia chilena* sp. nov. Both species have arcuate valves, tapering to long, narrow round-rostrate apices, convex dorsal margin and concave to straight ventral margin, However, *N. varelae* is longer (40.4-84.8 μm long), the striae and the fibulae are denser (53.8-60.2 and 12.7-16.0 in 10 μm respectively), the raphe is discontinuous and lies only along the convex margin, and externally, the terminal fissures are hooked towards the ventral margin. Although *Cymbellonitzschia chilena* sp. nov. differs in the shape of valves from all previously described species of the genus (among other features), we consider to place the new species in *Cymbellonitzschia*, and agree with Mann *et al.* (2021) in the sense of not making changes of genera or subgenera of the Bacillariaceae until further studies on their growth, diversity, valve ontogeny and molecular markers are made.

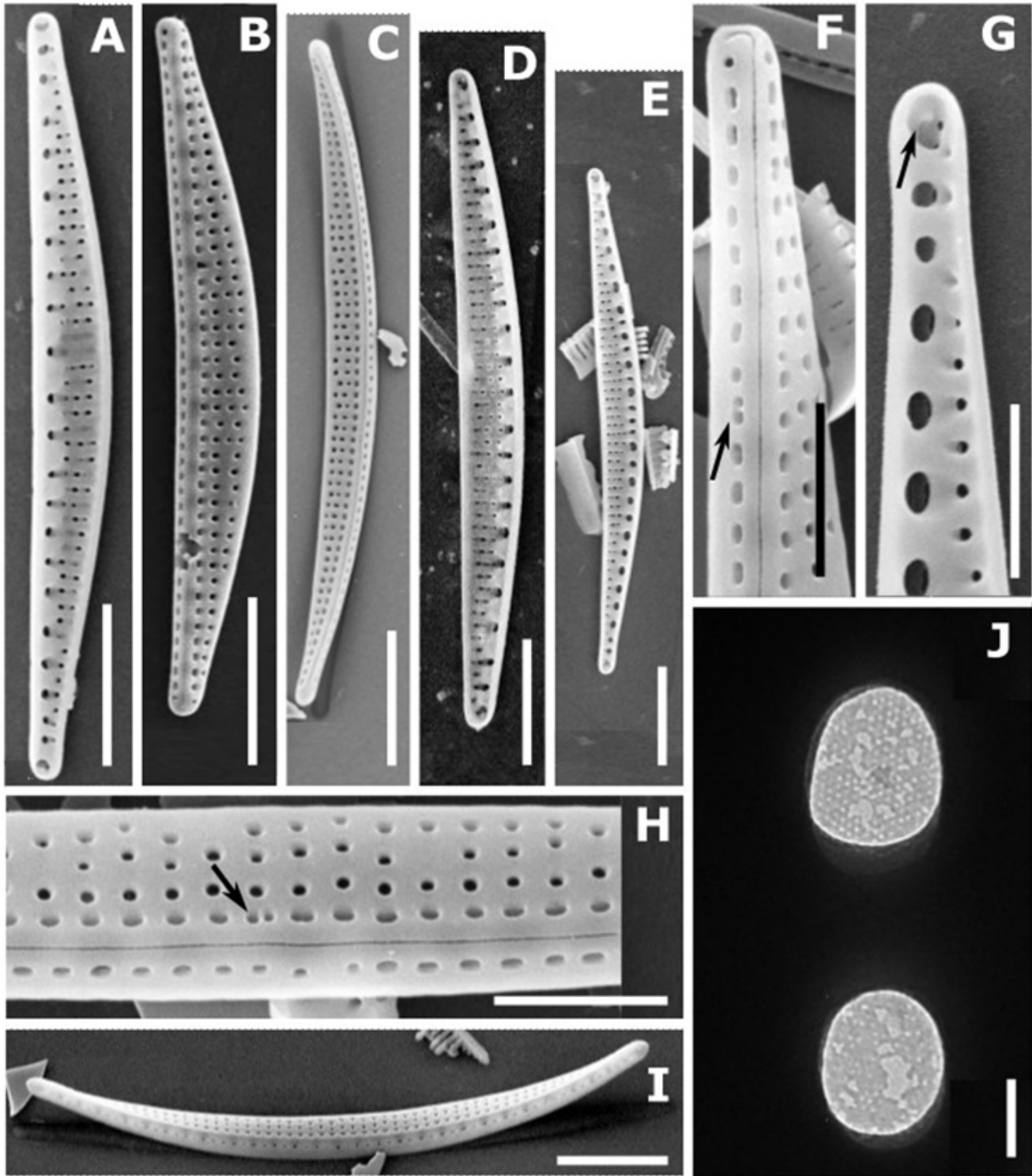


FIGURE 2. *Cymbellonitzschia chilena* sp. nov. (A-I) Scanning Electron Microscopy. (J) Transmission Electron Microscopy. (A, D, E, G) Internal view. (B, C, F, H, I) External view. (A-E) Valves elongated, arcuated, with protracted round-rostrate apices; striae are uniseriate, and parallel. (A, D) Ventral margin sub-linear; each fibula connected to 1-3 interstriae. (B, C, E) Ventral margin concave. (H) Raphe at the junction of the valve face and mantle, very thin, continuous; areolae rounded to elongated on de valve face, some terminate close to the raphe in two smaller and linked areolae (arrow). (B-C, F) Terminal fissures curved to the dorsal margin. (F, H) Valve mantle with one longitudinal row of elongated areolae, parallel to the raphe, some pairs of them are linked and smaller (arrow). (G) Internally, the raphe terminates in helictoglossa. (I) In girdle view the frustules are curved. (J) Areolae occluded by delicate external hymens.

Scale bars: A, B, D, E, I = 5 µm; C = 3 µm; F-H = 2 µm; J = 100 nm. / *Cymbellonitzschia chilena* sp. nov. (A-I) Microscopía Electrónica de Barrido; (J) Microscopía Electrónica de Transmisión. (A, D, E, G) Vista interior. (B, C, F, H, I) Vista exterior. (A-E) Valvas alargadas, arqueadas, con extremos prolongados, rostrado-redondeados; estrías uniseriadas, paralelas. (A, D) Margen ventral sub-lineal; cada fíbula se conecta con 1-3 interestrías. (B, C, E) Margen ventral cóncavo. (F, H) Rafe situado en la unión de la cara valvar con el manto, muy delgado, continuo; aréolas redondeadas a alargadas en la cara valvar; al lado del rafe pueden presentarse dos aréolas unidas, más pequeñas (flecha). (B-C, F) Fisura terminal del rafe curvada hacia el margen dorsal. (F) Manto valvar con una línea longitudinal de aréolas alargadas, paralela al rafe, un par de aréolas están unidas y son más pequeñas (flecha). (G) Internamente el rafe termina en helictoglosa. (I) Frústulos curvados en vista conectival. (J) Aréolas ocluidas por himenios externos. Escalas: A, B, D, E, I = 5 µm; C = 3 µm; F-H = 2 µm; J = 100 nm.

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