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SHORT COMMUNICATION

Distrionella coxiana, a new fragilarioid diatom species (Bacillariophyceae) from Tierra del Fuego, Patagonia, Argentina

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Background and aims – A few years ago, a new survey started of the freshwater diatom flora from peatbogs of Tierra del Fuego (southern Argentina). During this survey, an unknown fragilarioid diatom belonging to the genus *Distrionella* that could not be identified using the currently available literature was discovered.
Methods – Using both Light Microscopical and Scanning Electron Microscopical techniques, the morphology of the unknown *Distrionella* species has been analysed. The new taxon is properly described, illustrated and compared with all other possible similar *Distrionella* taxa, known worldwide.
Key results – *Distrionella coxiana* possesses a unique combination of morphological features that excludes conspecificity with all other members of the genus; it is characterized in having narrow, linear valves with small, capitate apices. Transapical ribs, a typical feature of the genus *Distrionella*, are only weakly developed. One rimoportula is observed close to the apices. Both apices have well-developed apical porefields. The girdle bands bear one complete row of poroids often accompanied by a second, incomplete row of small poroids. Notes on the occurrence and ecology of the new taxon are added.

Key words – Diatoms, Tierra del Fuego, *Distrionella*, new species, morphology.

INTRODUCTION

The diatom flora of Tierra del Fuego (TDF), the insular southernmost tip of Argentinian Patagonia, has been the subject of several large diatom studies in the past. Two of the most extensive studies were carried out by Cleve-Euler (1948) and Krasske (1949) both reporting on freshwater diatoms from several *Sphagnum* peatbogs. An overview of all studies discussing the diatom flora in the region is presented in Casa et al. (2018).

Recently, a new investigation began that examines the freshwater diatom communities in two peat bog areas, located close to Ushuaia, the capital of TDF. Dominant genera observed during this survey include *Pinnularia*, *Frustulia* (Casa et al. 2018), *Eunotia* and several cymbelloid taxa. During an analysis of the genus *Eunotia* (Casa et al. unpubl. res.), an unknown fragilaroid diatom, most likely belonging to the genus *Distrionella*, was recorded. Detailed light (LM) and scanning electron microscopy (SEM) analysis revealed a unique combination of morphological features that excludes conspecificity with all known *Distrionella* species.

The genus *Distrionella* was originally described in 1990 by Williams, based on *D. asterionelloides* D.M.Williams. The genus was separated from *Fragilaria* Lyngb. and *Diatoma* Bory based on the presence of thickened transapical ribs (absent in *Fragilaria*), a very simple thin sternum, unevenly spaced uniseriate striae (different from *Diatoma*) and a single row of small pores on the copulae (double row in *Diatoma*) (Williams 1990, Morales et al. 2005). Although several papers (Reichardt & Lange-Bertalot 1990, Van de Vijver et al. 2000) questioned the description of *Distrionella*, Morales et al. (2005) showed unambiguously the necessity to group these species in a separate genus, emending the description of several former *Fragilaria* species and transferring them

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Table 1 – **Table of comparison of all *Distrionella* taxa described worldwide.**
* measured based on illustrated valves in Rumrich et al. (2000).

	Distrionella incognita	*Distrionella asterionelloides*	*Distrionella husvikensis*	*Distrionella germainii*	*D. germainii* f. *acostata*	*Distrionella coxiana*
Valve length (µm)	20–116	25–75	3.6–25.2	20.5–85	c. 35–70*	25–55
Valve width (µm)	1.4–3.0	1–2	2.4–4.8	3.3–6.7	c. 2.5–4*	2–3.5
Number of striae in 10 µm	14–38	25–30	26–30	17–23	21–25*	21–26
Mantle plaques	absent	–	absent	present	–	present
Spines	absent	absent	occasionally spines absent	occasionally spines absent	present	poorly developed
Transapical ribs	present, 2–14 in 10 µm	well-developed, 2–4 in 10 µm	well-developed, 7–12 in 10 µm	present, 6–10 in 10 µm	absent	only weakly developed
Cingulum	several, single row of perforations	several open bands, single row of poroids	several, single row of perforations	several, single row of perforations	–	several, one complete row of perforations + several short series forming a second row

to the genus *Distrionella*. Since the original description in 1990, only five *Distrionella* taxa were recognized (Williams 1990, Reichardt & Lange-Bertalot 1990, Van de Vijver et al. 2000, Rumrich et al. 2000, Morales et al. 2005). Table 1 compares the morphology of all species.

The present paper describes unknown specimens from TDF as a new species of *Distrionella*, *Distrionella coxiana* Casa & Van de Vijver sp. nov. and compares them with all known species of *Distrionella*, especially with the most similar species *D. germainii* (E.Reichardt & Lange-Bert.) E.Morales, Bahls & W.R.Cody. Brief notes on its ecology are added.

MATERIAL AND METHODS

Study site

The recent diatom survey focused on two typical *Sphagnum magellanicum* Brid. dominated ombrotrophic peat bogs (Rancho Hambre Peatbog and Upper Andorra Valley Peatbog, Roig & Roig 2004). Andorra is located about 20 km north from Ushuaia in the Andorra Valley (54°44′S, 68°20′W), whereas Rancho Hambre is located nearly 50 km west from Ushuaia city (55°44′S, 67°49′W). Detailed environmental information for both locations can be found in Casa et al. (2017, 2018). A large proportion of the peatbogs is covered by many pools of different size, with their bottoms covered either by a layer of organic debris (clear pools) or by *Sphagnum* mosses (vegetated pools). The water chemistry of the waterbodies is characterized by very low conductivity, low nutrient levels and acid pH values, typical of rainwater-fed ombrotrophic environments (Casa et al. 2018). The new *Distrionella* species was observed so far in some sediments and periphyton samples from both locations.

Sample collection

During the spring/summer season in 2014 and 2016 (Southern Hemisphere), a series of pools was sampled in the Rancho Hambre and Andorra Valley peatbogs. In each pool several samples were collected. One sample was taken from the upper layer of the bottom sediment (= SED samples) whereas several others were collected from different aquatic mosses, including *Sphagnum* (= PER samples).

Methods

Samples were preserved with 95% ethanol and subsamples prepared for LM observation following the method described in van der Werff (1955). Subsamples were cleaned by adding 37 % H_2O_2 and heating to 80°C for about 1 h. The reaction was completed by addition of saturated $KMnO_4$. Following digestion and centrifugation (three times 10 minutes at 3,700 x g), cleaned material was diluted with distilled water to avoid excessive concentrations of diatom valves on the slides. Cleaned diatom material was mounted in Naphrax® (Brunel Microscopes Ltd. Wiltshire, UK: http://www.brunelmicroscopes.co.uk/naphrax.html). All slides were studied at x1000 magnification under oil immersion using an Olympus® BX53 microscope equipped with Differential Interference Contrast (Nomarski) optics. For scanning electron microscopy (SEM), parts of the oxidized suspensions were filtered through a 5 µm Isopore™ polycarbonate membrane filter (Merck Millipore). The stubs were sputter-coated with a Gold-Palladium layer of 10 nm and studied in a JEOL-JSM-7100F (Meise Botanic Garden, Belgium). Samples and slides are stored at the BR-collection, Meise Botanic Garden (Belgium). Isotypes are kept at the University of Antwerp (Belgium) and the National Museum of Natural History (La Plata, Argentina; LPC). All material is available upon request. Diatom terminology follows Ross et al. (1979) for stria/are-

ola structure, Williams (1990) and Morales et al. (2005) for genus characteristics. A comparison based on morphological features was made using all publications on the genus *Distrionella* (Williams, 1990, Reichardt & Lange-Bertalot 1990, Van de Vijver et al. 2000, Rumrich et al. 2000, Morales et al. 2005) and relevant publications on the freshwater diatom flora of southern South America (Frenguelli 1923, 1924a, 1924b, 1924c, 1953, Krasske 1939, 1949, Cleve-Euler 1948, table 1).

RESULTS

Distrionella coxiana Casa & Van de Vijver, **sp. nov.**
Figs 1–3

Type material – Argentina, Tierra del Fuego, Rancho Hambre Peatbog, sample RH2016-CP4-PER2 (54°44′41.51″S, 67°49′31.69″W), 21 Nov. 2016, *V. Casa* s.n. (holo-: BR, slide BR-4527; iso-: University of Antwerp, Belgium, slide PLP-351; iso-: LPC, slide LPC-15377).

Description: LM – Frustules rectangular in girdle view. Valves linear with strictly parallel margins and small, protracted, capitate apices. Apices never wider than valve. Valve dimensions (n = 50): length 25–55 µm, width 2–3.5 µm. Sternum very narrow (hard to discern in LM). When present, slightly thickened transapical ribs clearly visible, but valves occasionally also lacking ribs. Striae parallel throughout entire valve, irregularly spaced, 21–26 in 10 µm. Striae on both sides of sternum always alternating, never opposite. Areolae not discernible in LM.

Description: SEM – Girdle composed of at least two perforated copulae. Occasionally a short series of small poroids present adjacent to a continuous series of poroids (fig. 2C). Striae uniseriate, composed of regularly spaced, small rounded areolae (fig. 2B & D). Volae not observed. Striae continue without interruption onto mantle, occupying approximately ¾ of mantle width. Faint, transapical slits continuing from striae to mantle margin (fig. 2C & E, arrows). Apical pore fields well developed at both apices (fig. 2A), composed of densely packed rows of poroids surrounding each pole. Poroids located on valve face continuing without interruption onto mantle, mantle near margin without poroids (figs 2B–D & 3A–B). One apical rimoportula present per valve, located parallel to transapical striae replacing 2–3 areolae on one side of valve (figs 2B, D & 3C). Irregularly shaped plaques present on mantle margin (fig. 2E). Small, conical spines located on virgae along valve margin (fig. 2A & D). Internally, transapical ribs weakly developed or absent (fig. 3A & C).

Etymology – The new species is named after our friend and colleague, Dr. Eileen J. Cox (Natural History Museum London, UK) on the occasion of her 70th birthday.

Ecology and associated diatom flora – The new *Distrionella* species was found in a few samples from the Rancho Hambre peatbog and in a beaver pond in the Andorra Val-

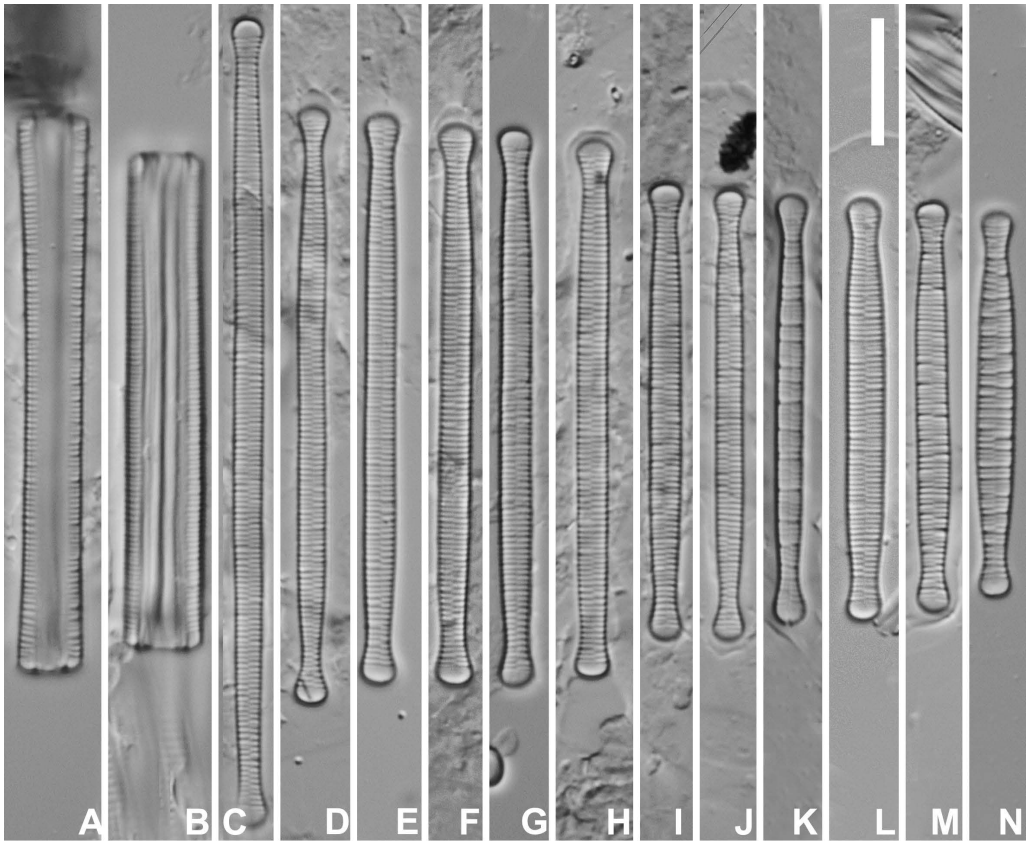

Figure 1 – *Distrionella coxiana*, LM of the type population from Rancho Hambre, Tierra del Fuego (sample RH2016-CP4-PER2): A & B, LM views of two entire frustules in girdle view; C–N, LM views of several valves in valve face view showing the observed size range. Scale bar = 10 µm.

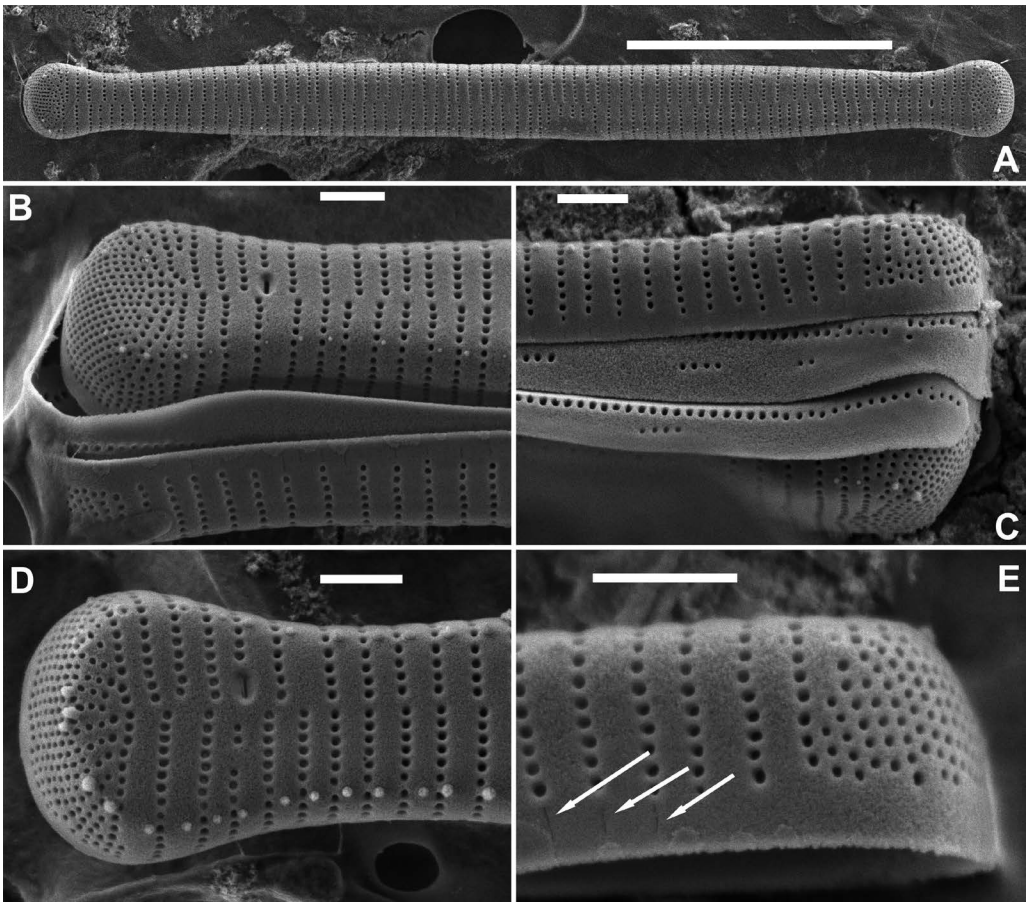

Figure 2 – *Distrionella coxiana*, SEM of the type population from Rancho Hambre, Tierra del Fuego (sample RH2016-CP4-PER2): A, external view of an entire valve; B, external detail of the valve apex showing the apical porefield and the rimoportula; note the presence of the small spines and the perforations of the girdle bands; C, external detail of the girdle bands showing the row of poroids on the copulae, the second row is not continuous but consists of short lines of poroids; D, external detail of the valve apex showing the apical porefield and the position of the rimoportula; E, external detail of the valve mantle with small plaques adjacent to the margin and the hyaline border. The arrows indicate small slitlike areolae on the mantle edge. Scale bars: A = 10 µm; B–E = 1 µm.

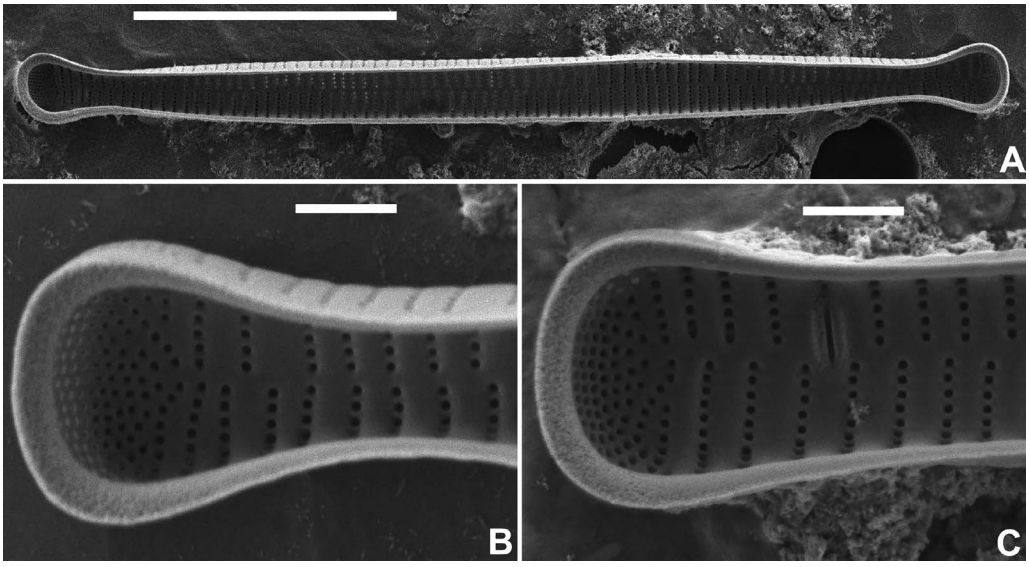

Figure 3 – *Distrionella coxiana*, SEM of the type population from Rancho Hambre, Tierra del Fuego (sample RH2016-CP4-PER2): A, SEM internal view of an entire valve; B, SEM internal detail of the valve apex showing the apical porefield but lacking a rimoportula; C, SEM internal detail of the valve apex showing the apical porefield and the rimoportula. Scale bars: A = 10 µm; B & C = 1 µm.

ley peatbog (Casa, pers. obs.). The largest population was found in periphytic growth on *Sphagnum fimbriatum* Wilson, in a clear pool, located in the Rancho Hambre peatbog. This pool was acidic (pH 6.1), with a specific conductance of 25 µS/cm. Concentration of total nitrogen was 9020 µg/L, and total phosphorus was 187 µg/L. Accompanying diatom taxa included several unknown *Eunotia* taxa (Casa et al. unpubl. res.), *Eunotia tenuivalva* Simonsen, *Encyonema* cf. *neogracile* Krammer, *Tabellaria flocculosa* (Roth) Kütz. and *Gomphonema* cf. *exilissimum* (Grunow) Lange-Bert. & E.Reichardt). Smaller populations (< 1% of the total diatom counts) of *D. coxiana* were found in nearby pools. In some samples, mixed populations with *D. germainii* were observed although the number of *D. coxiana* valves was always low in these locations.

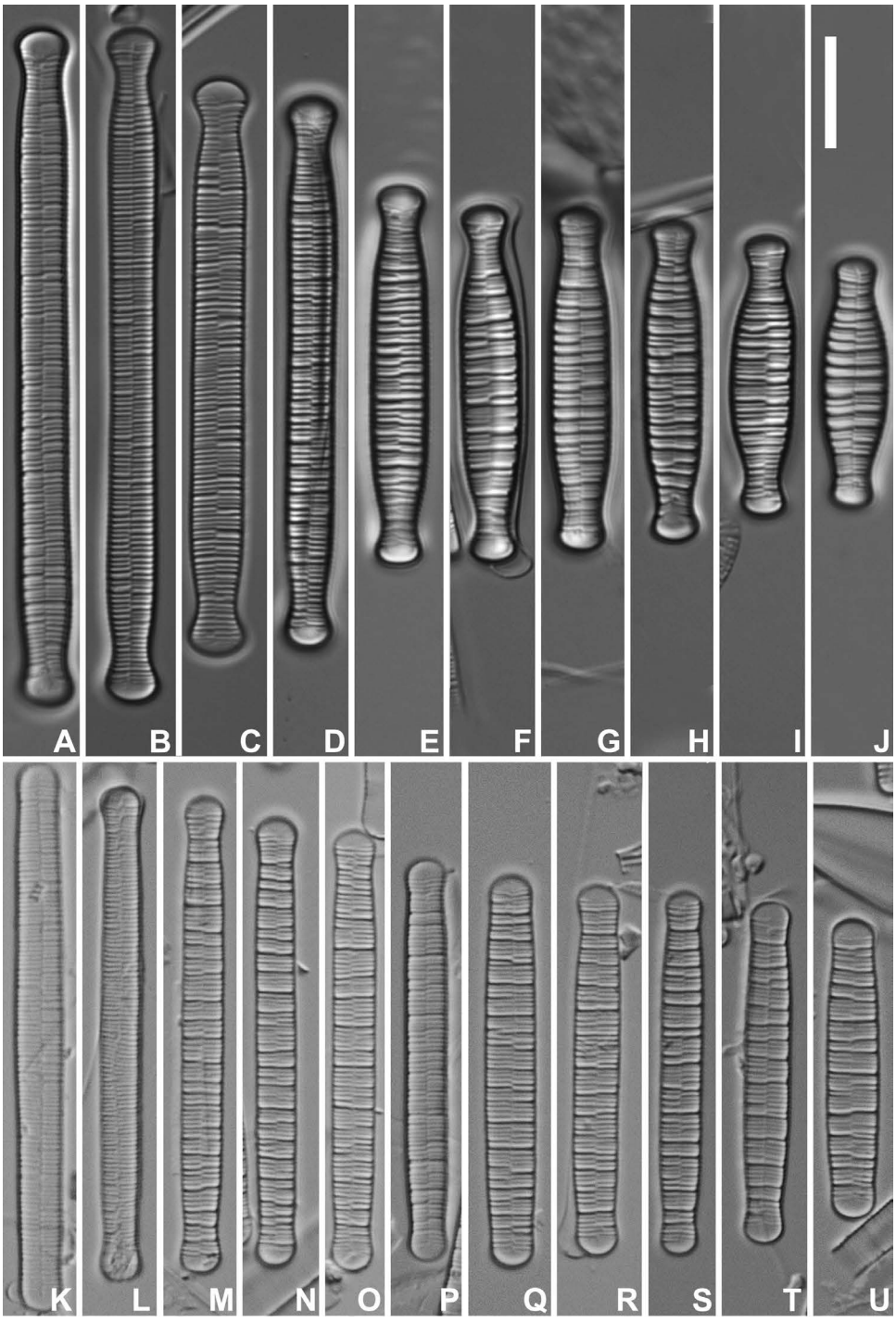

Figure 4 – *Distrionella germainii*. Different populations from the sub-Antarctic Region. LM views of valves in valve face view showing the observed size range and the variability of the transapical ribs and the valve outline: A–J, population from Val Studer, Iles Kerguelen (sample KER-BM518); K–U, population from Stromness Bay, South Georgia (sample SG-W374). Scale bar = 10 µm.

DISCUSSION

The new species clearly belongs to the genus *Distrionella* as emended by Morales et al. (2005) and not to the genus *Diatoma* (Williams 1985). The uniseriate striae are irregularly arranged, and composed of small, rounded areolae. Grouping of striae, as is the case in the genus *Diatoma*, was never observed (Williams 1985). Thick transapical ribs, although sometimes visible in LM, were rarely well developed internally, contrary to the well-developed transapical ribs in *Diatoma*. The girdle bands only bear one complete row of small poroids, with a second row present that is composed of short lines of poroids. The girdle bands in *Diatoma* always have two complete rows of poroids. Spines are present, another feature never observed in *Diatoma* but often seen in *Distrionella*.

Including the new species from TDF six *Distrionella* species are currently known worldwide and Table 1 compares the morphological features of these species. None of the previously described species show the same combination of morphological features as *D. coxiana*. *Distrionella incognita* (E.Reichardt) D.M.Williams is also narrow in valve outline but has more clearly developed transapical ribs and lacks spines (Reichardt 1988). Spines are usually prominent in *D. coxiana*, although in some valves spines may be missing or eroded. The girdle bands in *D. incognita* do not have a second row of poroids consisting of short series of poroids as is the case in *D. coxiana*. *Distrionella asterionelloides* D.M.Williams, often considered as a synonym to *D. incognita* and described from Scotland (Williams, 1990), has prominent transapical ribs, lacks spines and has a lower valve width (1–2 µm vs. 2–3.5 µm). Probably the most similar taxon is *D. germainii*, a widespread species on the sub-Antarctic islands in the southern Indian and Atlantic Ocean (Van de Vijver & Beyens 1996, Kellogg & Kellogg 2002, Van de Vijver et al. 2002). *D. germainii* is also found on the Islas Malvinas/Falkland Islands (Ingrid, Jüttner, Cardiff, Wales, pers. comm.) and the Tristan da Cunha archipelago (Van de Vijver pers. obs.). *Distrionella germainii* has more robust valves, a larger valve width (3.5–6.5 µm vs. 2–3.5 µm) and a lower number of striae (17–23 vs. 21–26 in 10 µm), although there can be a small overlap in stria density. The original plates in Reichardt & Lange-Bertalot (1990) were published with a printing error reducing the plates to only 83% of their original size. In (printed) distributed reprints, a note was added to point to this error (Van de Vijver, pers. obs.). The valve margins are mostly parallel but quite often valves with weakly to even distinctly convex margins can be found (Le Cohu 1999, Van de Vijver et al. 2002). *Distrionella germainii* often has a double row of marginal spines (see Reichardt & Lange-Bertalot 1990: fig. 13), broader valve apices and girdle bands with only one row of small poroids (Reichardt & Lange-Bertalot 1990, Le Cohu 1999). In most populations, *D. germainii* shows a prominent rimoportula located on the sternum although in some populations, the rimoportula can also replace, asymmetrically, one of the last striae (Le Cohu 1999). Although the valve outline, presence of transapical ribs and shape of the apices vary between the different populations on sub-Antarctic islands, *D. germainii* is always wider than *D. coxiana*. Figure 4A–J show a population (sample KER-BM518) of *D. germainii* collected from moss vegetation near the Val Studer area on Iles Kerguelen, the archipelago from where *D. germainii* was originally described (Reichardt & Lange-Bertalot 1990), and fig. 4K–U show a population from South Georgia (sample SG-W374), located more closely to TDF. *Distrionella germainii* var. *acostata* (Lange-Bert.) E.Morales et al. is similar in size (see Peng et al. 2017) but has larger capitate apices and lacks transapical ribs (Rumrich et al. 2000, Van de Vijver et al. 2000). *Distrionella husvikensis* (Van de Vijver et al.) Morales has shorter valves and apices which are hardly protracted and not capitate

Another taxon that bears similarities with *D. coxiana* is *Diatoma elongatum* var. *fuegensis* A.Cleve, described by Cleve-Euler in 1948 from Tierra del Fuego. Unfortunately, all that is known from the species are two line drawings published in Cleve-Euler (1948) and four LM images in Williams (1990), the latter showing robust valves with linear to slightly convex valve margins. The valve width of the illustrated specimens is 3.5–5 µm. We consider that *Diatoma elongatum* var. *fuegensis* is more likely *D. germainii* than *D. coxiana*.

The species studied here was most probably seen previously in Tierra del Fuego by Frenguelli (1924) who showed several valves (plate 10, figs 22–25) identified as *Diatoma elongatum* C.Agardh (figs 22–24) and *D. elongatum* var. *tenuis* (C.Agardh) Van Heurck (fig. 25). The latter could be identical to *D. coxiana*. Krasske (1939, 1949) also mentioned the presence of *D. elongatum* and the variety *tenuis* but unfortunately, his records are not illustrated. Since we did not find the genus *Diatoma* in our material from TDF, it is possible that these earlier records represent either *D. germainii* (*D. elongatum*) or *D. coxiana* (*D. elongatum* var. *tenuis*). Furthermore, Mataloni (1999) reported *Diatoma anceps* (Ehrenb.) Kirchner from Rancho Hambre and some other peatbogs in Tierra del Fuego. A new analysis of these samples has shown that this taxon was actually *D. coxiana.* This indicates that the genus *Distrionella* including *D. coxiana* might have a more widespread distribution in southern South America than currently known.

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