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Tryblionella persuadens comb. nov. (Bacillariaceae, Diatomeae): new observations on frustule morphology of a seldom recorded diatom

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ABSTRACT

The species originally described from brackish waters of the Venetian Lagoon as Nitzschia persuadens is a diatom rarely cited in the literature since its proposition and it is here recorded for the first time in a freshwater environment in South America. Morphological features of this species, such valve slightly panduriform, with a longitudinal straight fold of the valve face, poroidal areolae, and strongly eccentric raphe system clearly assign this species to Tryblionella, and the transfer was made. Here we present new observations on the frustule morphology and comparisons with related species. Light and scanning electron microscopy data of Tryblionella persuadens comb. nov. from Cachoeira River, Northeastern Brazil are documented.

Key words: Bacillariophyceae, Brazil, coastal river, Nitzschia persuadens.

INTRODUCTION

Tryblionella W. Smith is a widespread epipelagic genus, occurring in marine, brackish or high conductivity freshwaters (Round et al. 1990). This taxon was erected to generic status by Round et al. (1990), grouping the species included in four old sections from Nitzschia Hassal: Tryblionellae (W Smith) Grunow, Circumsutae Grunow, Apiculatae Grunow and Pseudotryblionella Grunow. This proposition have not been adopted by all diatomists, who considered unclear the selected discriminating criteria established (Witkowski et al. 2004). However, molecular studies performed on Bacillariaceae members have showed that Nitzschia sensu lato is not a monophyletic group, and probably should be split into several genera (Lundholm et al. 2002, Rimet et al. 2011). Rimet et al. (2011) advocated the taxonomic separation of Tryblionella and Psammodictyon D. G. Mann in Round, Crawford et Mann. (specially the later) from Nitzschia sensu stricto. Nevertheless, there are no sufficient representatives of Tryblionella included in those phylogenetic analyses for a reliable understanding about the relationships among nitzschiod genera. Whereas classification must be consistent with the phylogenetic relationships among groups, molecular tools combined with morphological features based on frustule, life form and plastids position (see Mann 1978) should clarify the genera consistency and their affiliations.

The species assigned to the genus Tryblionella were well documented, described and discussed in publications of the nineteenth (eg. Grunow
1862, Van Heurck 1880-1885, 1896, Peragallo and Peragallo 1897-1908) and twentieth centuries (Frenguelli 1923, 1924, 1942, Hustedt 1930, Mann 1978). All of them, except for Mann (1978), were illustrated by drawings only. There is no recent monograph dealing with all or large number of Tryblionella species. Witkowski et al. (2004) is the only recent study exclusively about Tryblionella representatives, redefining T. parvula (W. Smith) Ohtsuoka et Y. Fujita complex and describing four new species based on light and electron microscopy observations.

In Brazil, 23 Tryblionella taxa have been recorded; most of them are marine coastal taxa from the Southern region (Torgan et al. 1999, Procopiak et al. 2006, Bes and Torgan 2008, Tremarin et al. 2009, Silva et al. 2011). Little is known about coastal watershed diatom floras, therefore, the same occurs about possible interactions between continental and marine/estuarine communities.

A recent floristic survey of samples collected from a coastal river in Northeast Brazil revealed a species identified as Nitzschia persuadens Cholnoky. This taxon is rarely found in the literature, and its transfer is necessary based on its affinities with other Tryblionella taxa. This species is described here, based on light and electron microscopy, representing new observations on the frustule structure and the first record to South America.

**MATERIALS AND METHODS**

The Cachoeira River is situated in the Eastern Basin, state of Bahia, Northeast Brazil. This coastal river is around 500 km long and has 4,600 km² of drainage area. Inserted into the Atlantic rainforest, it rises to 800 m above sea level, covers major urban centers and flows onto the continental shelf off Ilhéus municipality (Torres et al. 2001).

Plankton and periphyton attached to Eichhornia crassipes (Martius) Solms-Lauber samples were collected from Cachoeira River, located at downtown Itabuna (14°47’14.24”S; 39°16’10.12”O), in July 2009, about 25 km away from the coast. Samples were fixed with 4% formalin solution.

Subsamples were cleaned with KMNO₄ and HCl, according to the method proposed by Simonsen (1974), modified by Moreira-Filho and Valente-Moreira (1981). Permanent slides were mounted with Naphrax® (R.I. = 1.74) and were stored at the herbarium of the Universidade Federal do Paraná (UPCB 65979, UPCB 65980).

Diatoms were observed, measured and photographed with a Olympus BX-40 light microscope equipped with phase contrast and a Olympus DP-71 digital imaging system.

For scanning electron microscopy (SEM) analyses, subsamples of cleaned valves were dried on stubs and coated with gold by sputter Balzers SCD030 and examined with a JEOL JSM 6360 at 15 kV. They are housed at the Electron Microscopy Center from the Universidade Federal do Paraná, Brazil.

**RESULTS**

Tryblionella persuadens (Cholnoky) Cavalcante, Tremarin et T. Ludwig comb. nov.


**LM DESCRIPTION:**

(Figs 1-13)

Valves linear-lanceolate, slightly panduriform, constricted in the median portion with cuneate-subrostrate apices, 18.1-20.0 µm long, 4.3-5.7 µm wide (n = 20). Valve face with a shallow longitudinal fold, sternum absent. Fibulae 12-16 in 10 µm, regularly distributed along the valve, the median two farther apart. Striae 28-30 in 10 µm, delicate, straight in most of the valve and curved toward the apices. Median stria sometimes wider than the others. Poroids inconspicuous.
Tryblionella persuadens comb. nov. (DIATOM)

SEM DESCRIPTION:
Valve face with a shallow longitudinal fold, externally depressed in the region near the raphe and elevated near the opposite margin (Figs 14-16). Margins bounded on one side by raphe strongly eccentric and on the other side by a narrow
marginal ridge, joining the valve face with a shallow mantle (Figs 14, 15). Striae uniseriate. Median striae sometimes biseriate (Fig. 15), seeming to be wider than the others under LM. Poroids round to rectangular, conspicuous only in electron microscopy, 37-40 in 10 µm, occluded by hymenes (Fig. 17). Mantle striated near the raphe, 28-30 striae in 10 µm, with granulated surface (Fig. 18). Girdle bands narrow, delicate, granulated (Fig. 16-18); valvocopula with one row of poroids (Fig. 16). Internally, fibulae are robust (Fig. 19). Poroids are formed by tiny round apertures, which ornate valve face as fibulae wall; there are no longitudinal sternum (Fig. 19-21).

**DISCUSSION**

The species described here is clearly assigned to *Tryblionella*. According to Round et al. (1990), it is a genus difficult to circumscribe. The distinction among *Tryblionella*, *Psammodictyon* and *Nitzschia sensu stricto* is given by a combination of diagnostic features, based on valve, raphe and fibula structures. However, very eccentric raphe system accompanied by a longitudinal straight fold of the valve face is useful to *Tryblionella* affiliation (Mann 1978). In the species protologue, Cholnoky (1961) have already noted that *T. persuadens* should be included in this group (former Section *Tryblionellae*).

Related species are *Tryblionella aerophila* (Hustedt) D.G. Mann in Round, Crawford et Mann, *T. bathurstensis* (Giffen) D.G. Mann in Round, Crawford et Mann, *T. sibula* (Giffen) D.G. Mann in Round, Crawford et Mann, *Nitzschia buschbeckii* Witkowski, Lange-Bertalot et Ruppel, and *N. ligowskii* Witkowski, Lange-Bertalot, Kociolek et Brzezińska. However, all of them present transapical striae interrupted along the apical axis by a longitudinal sternum, while *T. persuadens* does not. Moreover, *T. persuadens* has smaller length and width, fine structure, evidenced by denser fibulae and striae and median stria wider than the others. Main morphometric, ecologic and distributional distinctive features among these taxa are showed in Table I.

Based on type material analysis made by Krammer and Lange-Bertalot (1988) and by type illustration designated by Simonsen (1987), *T. aerophila* shows wider valves, broader fold, and coarser fibulae. Note that Figure 15 (Plate 51) from Krammer and Lange-Bertalot (1988), named ‘*N. aff. aerophila*’, is similar, if not identical to *T. persuadens*, and should not be confused with *T. aerophila*.

*Tryblionella bathurstensis* distinguishes from *T. persuadens* by having wider valves, less dense striae and faint, though conspicuous, poroids in LM, 28-30 in 10 µm, (Giffen 1970). On the other hand, *T. sibula* is longer, wider, shows more protracted apices, broad sternum and less dense fibulae and striae (Giffen 1973).

*Nitzschia ligowskii*, although a recently described species (Witkowski et al. 2004), used to be known by *N. subconstricta* Grunow, a name never validly published. It differs from *T. persuadens* by being longer and wider with lower striae density, and the marginal poroids are larger (Witkowski et al. 2004). Another similar species, *N. buschbeckii* is longer, wider, possesses a broad sternum, lower striae and fibulae densities and the poroids in the valve margins are coarser (Witkowski et al. 2004). According to our sense on phylogenetic relations among the Bacillariaceae genera, *N. ligowskii* and *N. buschbeckii* should be transferred to *Tryblionella*.

To a lesser extent, the species mentioned above also differ by habitat. *T. aerophila* seems to be a typically freshwater species. Krammer and Lange-Bertalot (1988) noted that individuals of *T. aerophila* from brackish water bodies recorded in Central and South America and South Africa cannot be safely considered as conspecific; *T. bathurstensis* is from brackish, while *T. sibula*, *N. ligowskii* and *N. buschbeckii* are from marine habitats. *T. persuadens* was found in brackish (original description) and freshwater (this study) environments.
<table>
<thead>
<tr>
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<th>Length (µm)</th>
<th>Width (µm)</th>
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<th>Striae in 10 µm</th>
<th>Poroid structure</th>
<th>Sternum</th>
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<td><strong>T. persuadens</strong></td>
<td>18.1-21</td>
<td>4.3-6</td>
<td>12-16</td>
<td>28-30</td>
<td>round to rectangular</td>
<td>absent</td>
<td>freshwater</td>
<td>coastal river, NE Brazil</td>
</tr>
<tr>
<td>Cholnoky (1961), protologue</td>
<td>18-25</td>
<td>6-7</td>
<td>12</td>
<td>32</td>
<td>-</td>
<td>absent</td>
<td>brackish</td>
<td>Venetian Lagoon, NE Italy</td>
</tr>
<tr>
<td><strong>T. aerophila</strong></td>
<td>23-31</td>
<td>6-8</td>
<td>9-11</td>
<td>26-30</td>
<td>-</td>
<td>present</td>
<td>brackish, epiphyte in a hepatic bank</td>
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</tr>
<tr>
<td>Krammer and Lange-Bertalot (1988), type material</td>
<td>20-25</td>
<td>8-9</td>
<td>11-13</td>
<td>22-25</td>
<td>-</td>
<td>present</td>
<td>brackish, on sand or mud</td>
<td>Kowie River, Cape Province, South Africa</td>
</tr>
<tr>
<td><strong>T. bathurstensis</strong></td>
<td>30-36</td>
<td>7-8</td>
<td>10-12</td>
<td>22-25</td>
<td>-</td>
<td>present</td>
<td>marine</td>
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</tr>
<tr>
<td>Giffen (1970), protologue</td>
<td>26-52</td>
<td>6.3-9.3</td>
<td>10-12</td>
<td>21-24</td>
<td>round, variable size</td>
<td>present</td>
<td>marine</td>
<td>Indian Ocean Sector, near to Artarctic continent</td>
</tr>
<tr>
<td><strong>Nitzschia buschbeckii</strong></td>
<td>10-57</td>
<td>5-9</td>
<td>12-15</td>
<td>22-27</td>
<td>round, variable size</td>
<td>present</td>
<td>brackish-marine</td>
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</tr>
<tr>
<td>Witkowski et al. (2004), protologue</td>
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<td>8-9</td>
<td>11-13</td>
<td>22-25</td>
<td>-</td>
<td>present</td>
<td>brackish, on sand or mud</td>
<td>Kowie River, Cape Province, South Africa</td>
</tr>
<tr>
<td><strong>Nitzschia ligowskii</strong></td>
<td>30-36</td>
<td>7-8</td>
<td>10-12</td>
<td>22-25</td>
<td>-</td>
<td>present</td>
<td>marine</td>
<td>St. Helena Bay, Cape Province, South Africa</td>
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</table>
Figs 16-21 - *Tryblionella persuadens* comb. nov. in SEM. 16. External view of whole valve. 17. Detail of central valve face, showing poroids structure. 18. Detail of granulated mantle. 19. Internal view of fibulae structure. 20. Valve in internal view. 21. Detail of valve center in internal view, showing internal poroid aperture. Scale Bars: Figs 16 = 5 µm; Figs 17-19, 21 = 1 µm; Fig. 20 = 2 µm.
Tryblionella persuadens is a poorly recorded taxon. Since its proposition, based on brackish population from Venetian Lagoon (Cholnoky 1961), the only records we have found were in Witkowski et al. (2000, p. 808 and 820), which are doubtful. Figure 7 (p. 808) showed a specimen with the following characteristics: 23.3 µm long, 10.6 µm wide, 11 fibulae and 24 striae in 10 µm, discernible poroids, which are not compatible with the original description of T. persuadens. The same occurs with figures 16 (p. 808) and 7 (p. 820), named N. cf. persuadens. Those individuals are wider (7.3, 8 µm) and show lower striae (21, 26 in 10 µm) and fibulae (10, 8 in 10 µm) densities. This is therefore the first record of this diatom in continental environments.

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REFERENCES


