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Haslea sigma (Naviculaceae, Bacillariophyta) a new sigmoid benthic species from salt marshes of Southern Brazil

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Abstract

A new sigmoid diatom species *Haslea sigma sp. nov.* was found alive in sediment composed of clay and silt in salt marshes in Southern Brazil. The species is morphologically distinctive by the following combination of characters: 1) sigmoid valve, 2) thickened virgae forming a pseudostauros, 3) central raphe fissures almost straight and 4) terminal raphe fissures slightly curved. It was analyzed in light and electron microscopy and compared with the sigmoid *Haslea nipkowii* and with other spindle-shaped *Haslea* taxa possessing a pseudostauros.

Key words: diatoms, benthic species, brackish water, *Haslea sigma sp. nov.*, taxonomy

Introduction

The genus *Haslea* was described by Simonsen (1974: 46) and interpreted as a link between the section Fusiformes Cleve (1894) of *Navicula* Bory (1822: 128), similar in outline and structure, and some species of *Gyrosigma* Hassall (1845: 435) and *Pleurosigma* W. Smith (1852: 2), which are similar in central nodule morphology. In the protologue the genus was characterized as having "outline spindle-shaped, with acute ends and convex sides rarely parallel in the middle", *Haslea ostrearia* (M. B. Gaillon) Simonsen (1974: 47) was designated as generitype, and eleven species of *Navicula* were transferred to the newly-erected genus and two new species were described.

Subsequently, Poulin *et al.* (2004) transferred *Gyrosigma nipkowii* Meister (1932: 43) to *Haslea* under the name *Haslea nipkowii* (Meister) Poulin & Massé (*in* Poulin *et al.* 2004: 184) based on ultrastructural features and molecular analysis. With this transfer, the genus began to include species with a sigmoid outline.

On the basis of criteria given by Simonsen (1974), Round *et al*. (1990), Massé *et al.* (2001), Poulin *et al.* (2004), and Cox & Williams (2006) *Haslea* can be characterized by presenting: two chloroplasts per cell with more than one pyrenoid per chloroplast (axially located); areolae square to rectangular occluded by hymenes internally and externally overlain by longitudinal strip usually continuous from pole to pole and an accessory rib along the raphe-sternum. Only some species of the genus have a pseudostauros (thickening of the central virgae).

So far, twenty-six taxa of *Haslea* are known, most of which are marine planktonic, with fusiform cells (Guiry & Guiry 2014, Simonsen 1974). *Haslea ostrearia* and *Haslea karadagensis* Davidovich, Gastineau & Mouget *in* Gastineau *et al.* (2012: 472) produces marennine (a water soluble blue pigment), while the other known species do not have this ability.

In the South Atlantic, four species of *Haslea* are known: *Haslea crucigera* (W. Smith) Simonsen (1974: 47), *Haslea wawrikae* (Hustedt) Simonsen (1974: 48) and *Haslea* cf. *trompii* (Cleve) Simonsen (1974: 47) were cited from the Brazilian coast (Torgan *et al.* 1999, Procopiak *et al.* 2006, Tremarin *et al.* 2009, Villac & Tenenbaum 2010, Eskinazi-Leça *et al.* 2013) and *Haslea spicula* (Hickie) Lange-Bertalot (1997: 75) was cited from the Uruguayan coast (Metzeltin *et al.* 2005).

This paper describes a new sigmoid and benthic diatom belonging to *Haslea* from salt marshes of South America and compare it with related taxa.

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Discussion

Haslea sigma sp. nov. resembles *H. nipkowii* in outline since both are the only species of the genus that have sigmoid valves. Differences may be summarized as follows: the new species has a pseudostauros, and terminal raphe fissures curved and bent to opposite sides, whereas *H. nipkowii* lacks pseudostauros and has T-shaped terminal raphe fissures (see Poulin *et al.* 2004: 189, Figs. 30, 31). Furthermore, *H. sigma* is shorter and narrower, and has a higher striae density than *H. nipkowii* (Table 1).

Presence of the pseudostauros is an important feature to delimit groups in *Haslea*. The new species has this feature, and a pseudostauros has also been found in *H. crucigera* (Wm. Smith) Simonsen (1974: 47)*, H. crucigeroides* (Hustedt) Simonsen (1974: 47)*, H. salstonica* Massé, Rincé & Cox (Massé *et al.* 2001: 619)*, H. spicula* (Hickie) Lange-Bertalot and *Haslea quarnerensoides* (Hustedt) Navarro, Micheli & Navarro (2000: 113). Massé *et al.* (2001) discussed the structure of the pseudostauros when comparing *H. salstonica* with *H. crucigera,* and they observed that in *H. crucigera* the development of the pseudostauros might be variable. Pseudostauros shape varied in the specimens of *H. sigma* examined during this study, some individuals had one thickened virga on each valve side and in others there was one virga on the primary side and two on the secondary side (white and black arrow-head in Fig. 29, 31). According to Round *et al.* (1990) a pseudostauros is lacking in planktonic species of *Haslea*, and based on this observation we could initially infer that the occurrence of this structure is restricted to the benthic species. However, subsequent studies have shown that some benthic species newly described (e.g. *H. nipkowii* and *H. pseudostrearia* Massé, Rincé & Cox *in* Massé et al. 2001: 622) do not have pseudostauros, either. Thus more study on this subject is needed.

Haslea sigma has an accessory rib along the raphe sternum on the primary side, a shorter rib on the secondary side of the valve and straight helictoglossae, such as is seen in *H. crucigera,* and *H. salstonica.* It cannot yet be compared with *H. crucigeroides, H. sulcata, H. spicula* and *H. quarnerensoides*, which seem to present accessory rib along the raphe sternum but have yet to be studied with SEM.

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